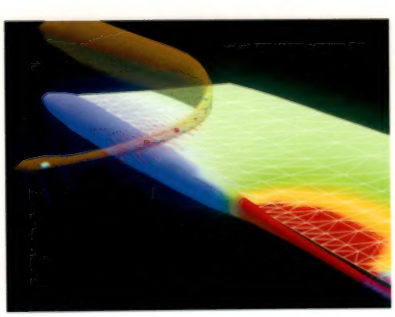
ELECTRONIC THEATER

ART AND DESIGN SHOW

SIGKIDS

THE EDGE

VROOM



VISUAL PROCEEDINGS

The Art and Interdisciplinary Programs of SIGGRAPH 94

COMPUTER GRAPHICS
Annual Conference Series, 1994

SIGGRAPH 94

A Publication of ACM SIGGRAPH

VISUAL PROCEEDINGS

The Art and Interdisciplinary Programs of SIGGRAPH 94

COMPUTER GRAPHICS Annual Conference Series, 1994

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A Publication of ACM SIGGRAPH

Visual Proceedings

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COMPUTER GRAPHICS
Annual Conference Series, 1994

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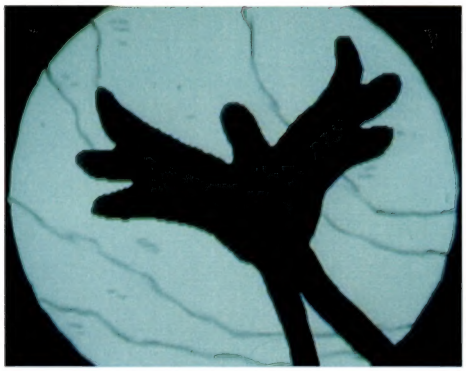
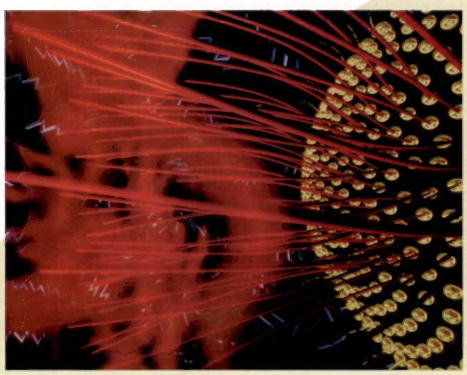
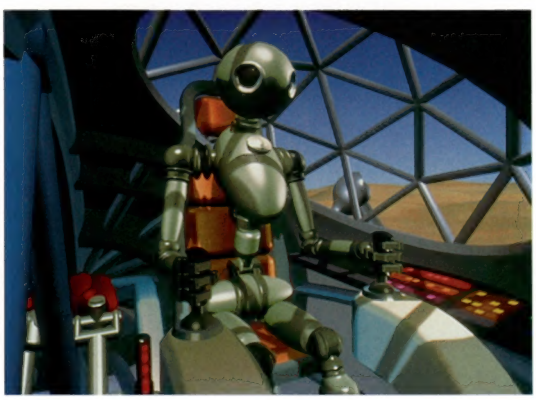
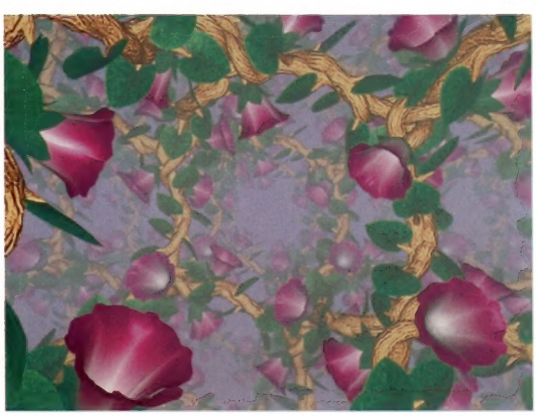




WELCOME TO THE ELECTRONIC THEATER



"Clyde in the Cockpit"
Dick Lundin, 1984
NYIT Computer Graphics Lab



"Inside a Quark"
Ned Greene, 1984
NYIT Computer Graphics Lab

Welcome to the SIGGRAPH 94 Electronic Theater, a celebration of outstanding computer animation created during the past year. We received 460 entries from 23 countries, totaling over 22 hours of viewing material. From this material, 32 pieces were selected for this year's show.

Audience participation returns to the Electronic Theater at SIGGRAPH 94 with the premier of Loren Carpenter's latest generation of the Cinematrix Interactive Entertainment System. The Electronic Theater audience interacts with real-time stereoscopic, high-definition images as the computer interprets the position of their wands. Another first for the Electronic Theater is the presentation of computer animation in stereoscopic HDTV.

We are very fortunate to present two works of historical significance that have not been publicly shown in 10 years. Ed Catmull left the University of Utah 20 years ago and founded the Computer Graphics Lab at the New York Institute of Technology; the lab closed its doors in 1992. The NYIT reel capped the SIGGRAPH 84 Electronic Theater, and in retrospect, this may have been the high-water mark for animation from NYIT. This year's show includes two segments from that historic reel: Ned Greene's animation cycle of a labyrinth of vines and Dick Lundin's celebrated animation of the mechanical ant from "The Works." We are grateful to Ned Greene for making this footage available.

The work in the SIGGRAPH 94 Electronic Theater is united by a common vision shared by the jury and ourselves, and we hope you enjoy the presentation as much as we enjoyed putting it all together.

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Jury Statement

We strove to offer a selection judged by a consistent criterion: we looked for computer graphics that made a significant statement, regardless of platform. The selected pieces not only embody high visual quality, but they also break new technical ground, explore new stylistic directions, or carry a powerful aesthetic message. Each piece was selected by unanimous agreement or by forceful argument for its inclusion. Additionally, we tried to include entire works as often as possible in the hope of preserving the artistic integrity of each piece.

Many entries not chosen represent excellent work that meets the highest standards and would almost certainly have been included in the Electronic Theater in previous years. We placed them in the Screening Room because of time limitations. We ask you to consider the Screening Room as an extension of the Electronic Theater.

Jim Kajiya
Microsoft Corporation

Jean Kim
Magic Box Productions

Alex Seiden
Industrial Light and Magic

Joan Staveley
Ringling School of Art and Design

Committee

We would like to thank our committee members for their dedication to making this a successful Electronic Theater.

Loren Carpenter
Pixar

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Gina Coniglio
Ogilvy & Mather

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Jean Kim
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University of Illinois

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Acknowledgements

This show could not have been completed without the generosity of the following corporations and individuals:

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Sony Corporation of America
HD/LA
Editel – Chicago
Magic Box Productions
SAIC, Information Display Systems
Microsoft Corporation
Evans & Sutherland Computer Corporation
Silicon Graphics, Inc.
Iwerks Entertainment
Vertigo Technology
StereoGraphics Corporation
Theatric Support
Polaroid Corporation
Autodesk, Inc.
RFX, Inc.
Industrial Light & Magic
Crawford Post
DESIGN efx
Walt Disney Company/Feature Animation
SIGGRAPH Video Review
Electronic Visualization Laboratory, University of Illinois at Chicago
Savannah College of Art and Design
Prix Ars Electronica
big Research

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D.L. Bean
Brian Blau
Mark Boyle
Leona Caffey
Gary Clark
Nancy Clemens
Jim Costigan
Marc Daigle
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Ian DeFanti
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John Patronski & all the guys
John Michael Pierobon
Tom Rieke
Lila Rosenthal
Marie-Louise Sarapata
Dr. Christine Schöpf
Dino Schweitzer
Cindy Stark
Bob Tanaka
Janet Tanaka
Carol Taylor
Barbara Voss
Scott A. Williams

CINEMATRIX Kinoetic Adventure

The SIGGRAPH 91 Electronic Theater in Las Vegas introduced attendees to a new experience. For the first time in recorded history, 5,000 people played a video game together.

The CINEMATRIX Interactive Entertainment System elevates audiences from the traditional position of sitting passively to simultaneously controlling screen images in a focused group effort. Loren Carpenter's invention provides a "mouse" for the audience; each input device is comparatively inexpensive and requires no wires or batteries. The latest developments and new experiments in this technology are in store for the SIGGRAPH 94 Electronic Theater audience.

There are plenty of challenges and excitement as CINEMATRIX unveils its newest interactions. In addition to its own games, CINEMATRIX and Silicon Graphics, Inc. present a game developed by Paradigm Simulation. The audience gains collective experience by cooperating to control these fast-paced graphics.

The audience then applies its cooperative experience to a fantasy adventure: The Loch Ness Expedition, created by Evans & Sutherland for their Virtual Adventures attraction, a coordinated development with Iwerks Entertainment. The entire audience interacts in a detailed virtual underwater world projected in stereoscopic HDTV. The Loch Ness Expedition presents more functions and greater challenges to the audience, which divides into several teams to run the submarine and work toward the common goal of saving Nessie's eggs.

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CINEMATRIX
Hardware
Custom industrial image processors
Silicon Graphics workstation
Software
all custom

Evans & Sutherland
Hardware
ESIG-2000 Real-Time Image Generators
Software
all custom

Silicon Graphics Hardware
Silicon Graphics Onyx Reality Engine II

Paradigm Software
Vega Software Environment

Demonstration Contributors
CINEMATRIX Interactive Entertainment Systems, Inc.
Evans & Sutherland Computer Corporation
Paradigm Simulation
Silicon Graphics, Inc.

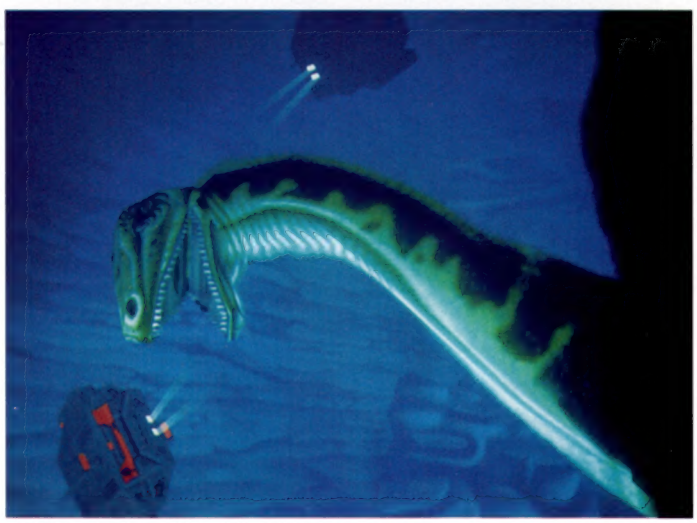

Image courtesy of Evans & Sutherland Computer Corp.

The SIGGRAPH 91 Electronic Theater audience used color-coded reflective wands to interact with the computer.

500 NATIONS

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Archeologist: John Pohl
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Art Director: Peter Lloyd
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Costume Designer: Janet Grower
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Software Programmer: Axel Dirksen
Systems Manager: Kathi Samec
Editors: Rick McDonald, Curtis Bieber

XO Digital Arts
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Chief Matte Painter: Chris Evans
Digital Matte Painter: Brian Flora
Camera Operator: Wade Childress

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SOFWARE
Harry Paint Box

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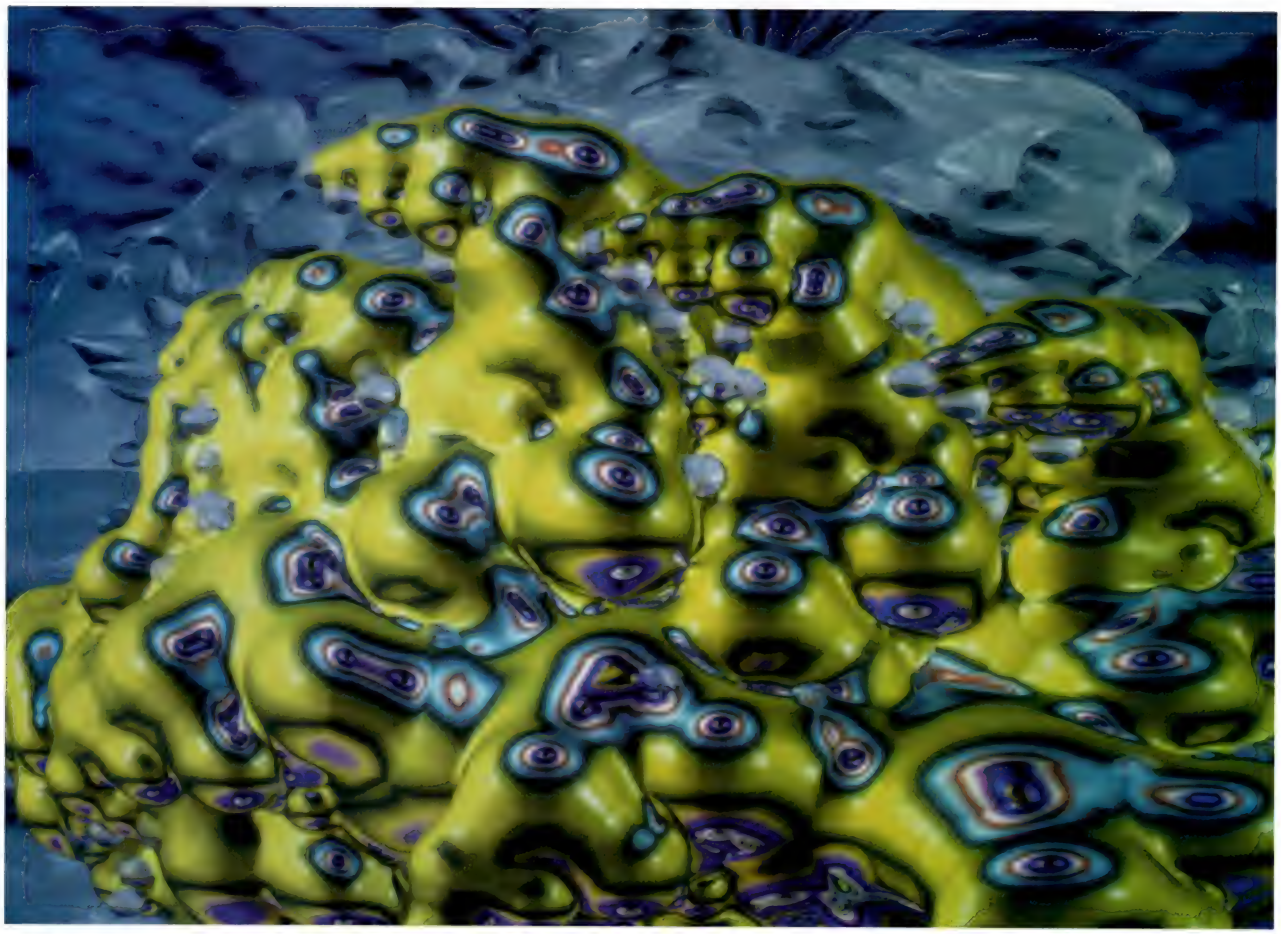

Stereoscopic HDTV

Artificial Life Soup: 'COACERVATE'

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SOFTWARE
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NTT Hi Lab
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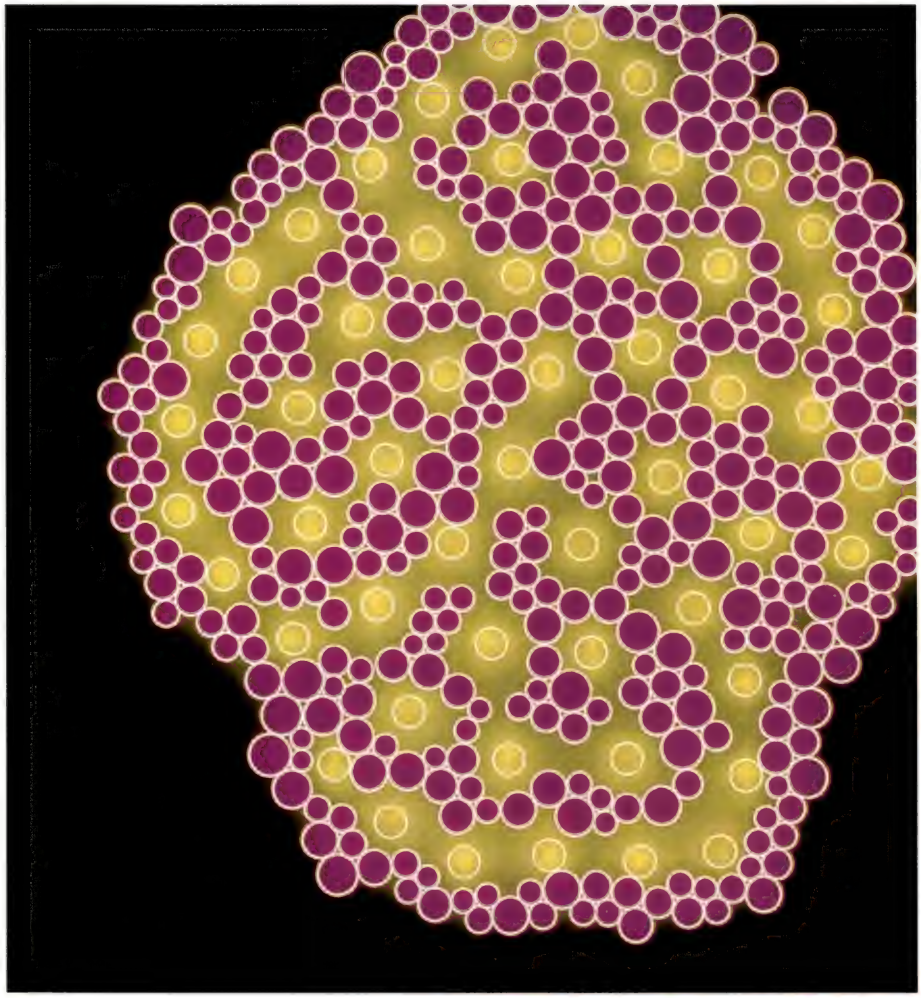
Sound: Tropical Systers



Cells

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Alpha, IBM RS6000

SOFTWARE
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SOFTWARE
Rhythm & Hues Studios
proprietary

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Producer: Liz Ralston
Assistant Producer: Leslie Galka
Head Technical Director:
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Technical Directors:
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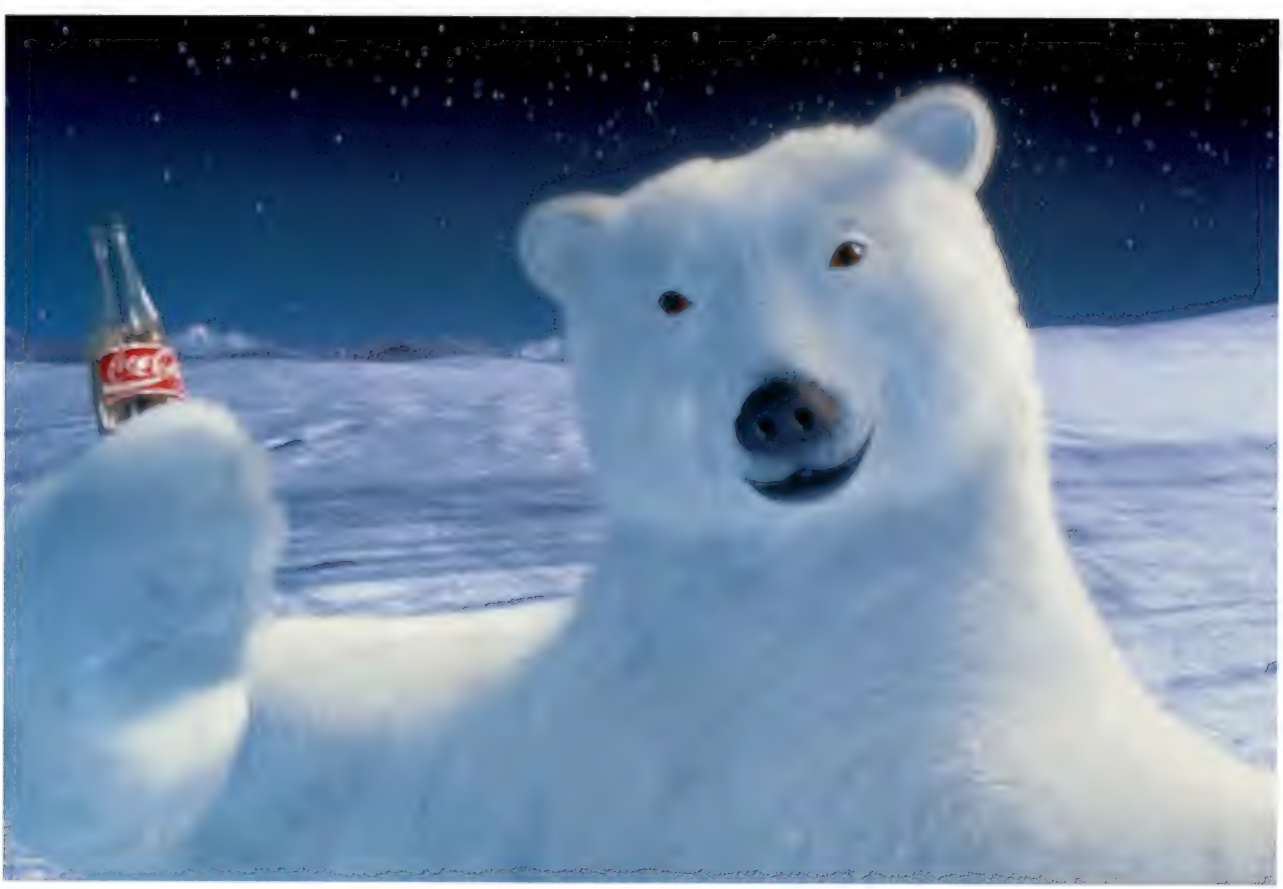
Georgia Cano, Todd Shifflett
Animator: Sylvia Wong
Modelers: Keith Hunter,
Nancy Klimley,
Steve Ziolkowski
Software Support: Mark Henne,
Richard Moster,
Keith Goldfarb, Paul A. Newell
Production Manager:
John Hughes
Production Company:
Sierra Hotel Productions
Director: Ken Stewart
Agency: Creative Artists Agency
Co-Creative Directors:
Shelly Hochron, Len Fink
Producer: Robert Parker
Client: Coca-Cola



Coke 'Comic Hero' Japan

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SGI

SOFTWARE
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SOFTWARE
Custom

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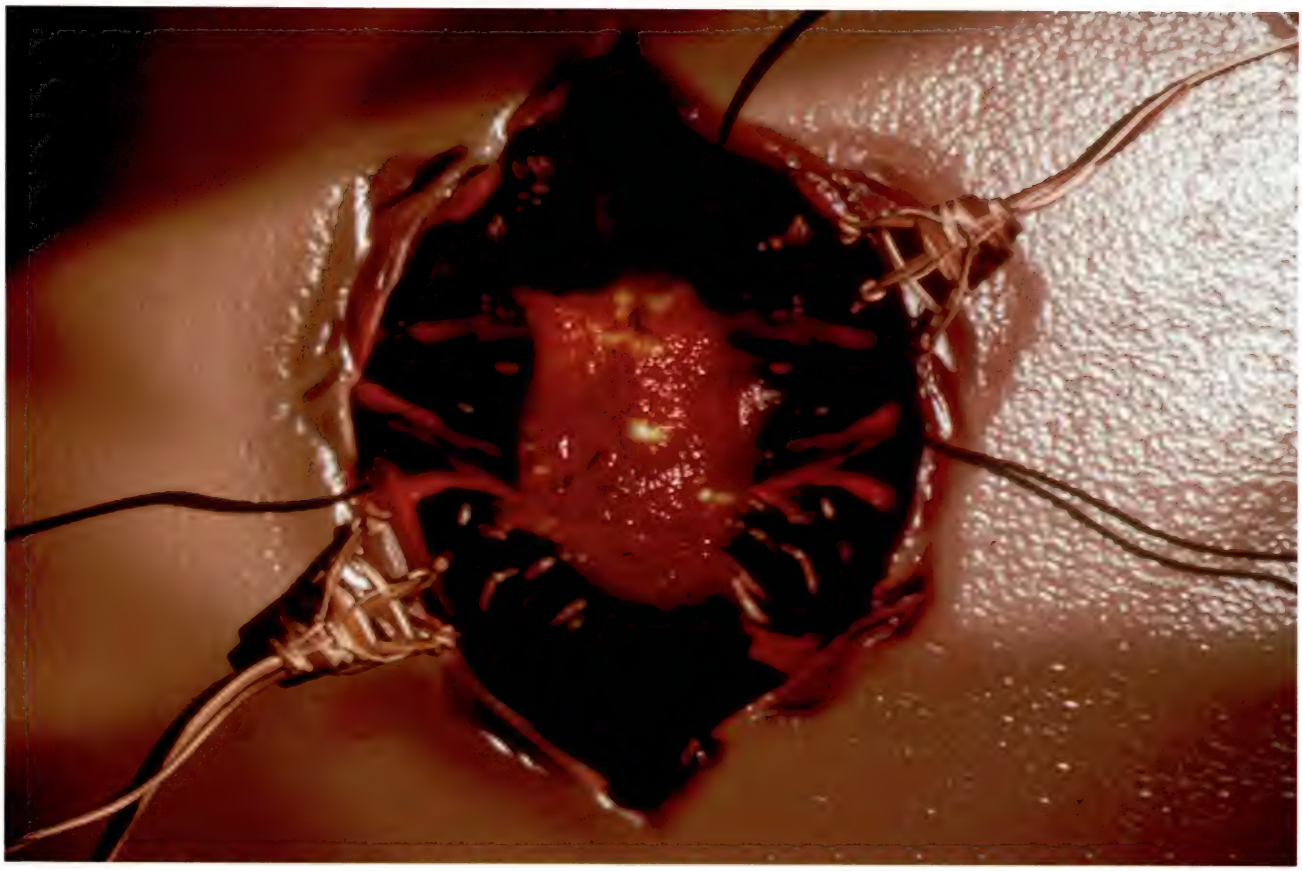

Dead Air
(Mind Over Matter)

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Special Thanks:
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SOFTWARE
SOFTIMAGE Animation and Modeling; Alias Modeling; Pixar RenderMan; Parallax Painting; ILM proprietary animation, modeling, rendering and compositing

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Executive in Charge of Digital Effects: Tom Williams
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SOFTWARE
Custom

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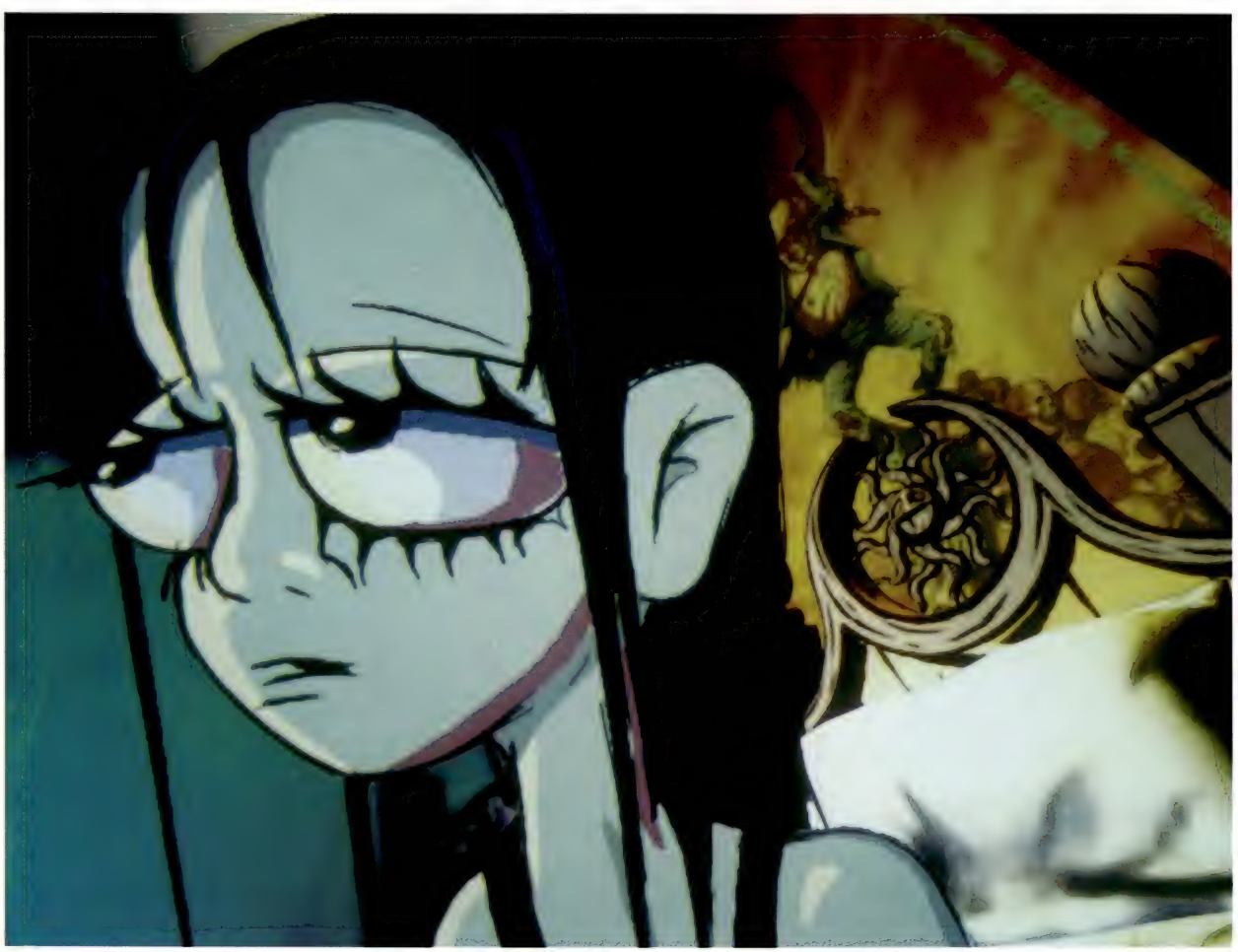

The Holy Bird

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HARDWARE
IBM RISC/6000

SOFTWARE
DDS, Feather, Wavefront

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Atsuko Katakura
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Song: Akiko Kakihana
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The Lion King
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Listerine 'Arrows'

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SOFTWARE
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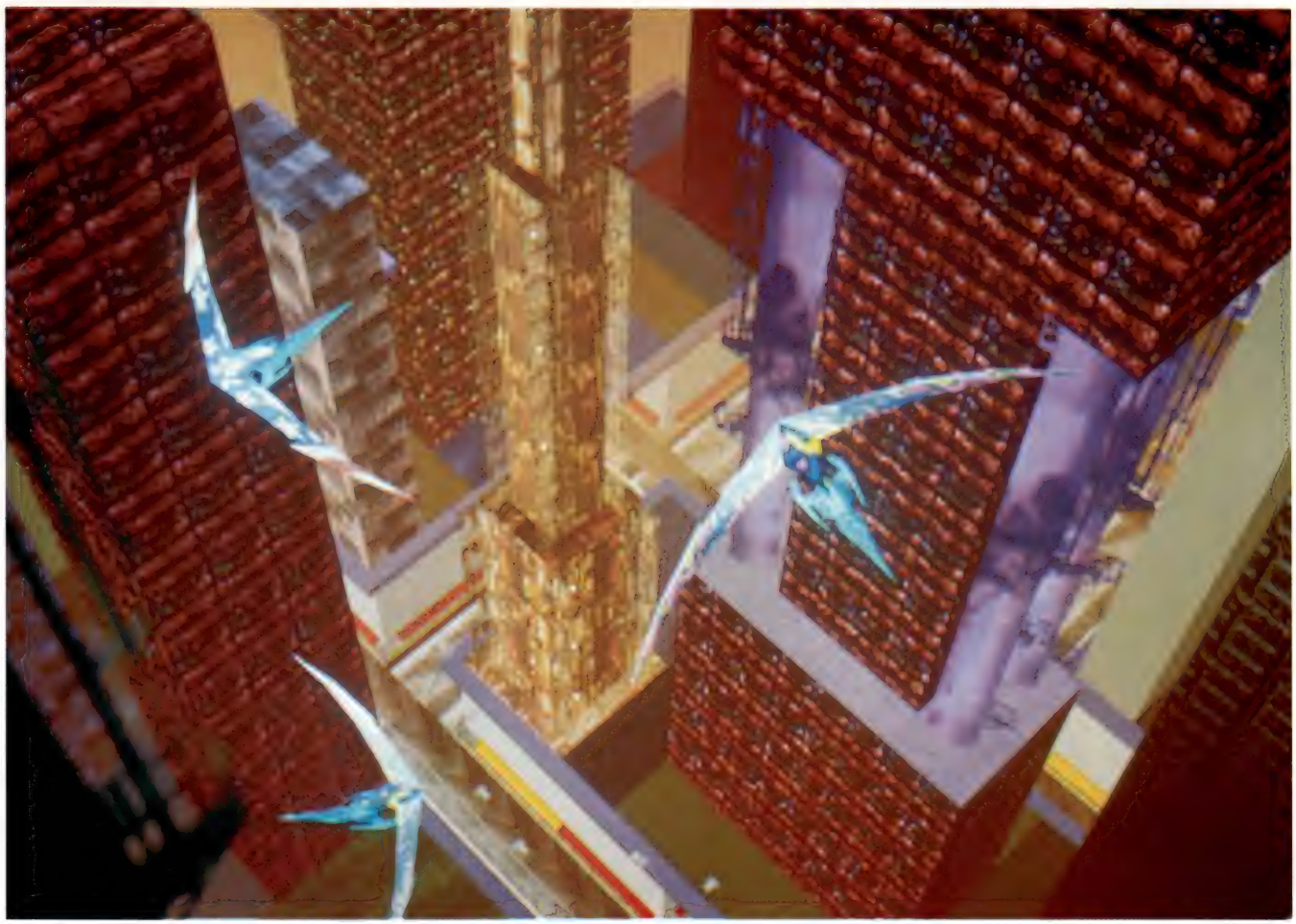
Courtesy of Pinnacle Group

Stereoscopic HDTV



The Mask

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PRODUCER
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SOFTWARE
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Thanks also to the National Science Foundation

Stereoscopic HDTV

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SOFTWARE
Proprietary, Wavefront, Symbolics

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Sound Modulator: Kelly Kleider
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Animator: Steve Lee
Sculptor: Tom Rubalcava
Animation Cameraperson: Carter Tomassi
ALIVE! Software created by deGraf / Associates and (Colossal) Pictures
Bodysuit created by (Colossal) Pictures using Polhemus Fastraks
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Post-production facilities provided by Crawford Communications, Inc.

A Nice Easy Turquoise

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digitizer

SOFTWARE
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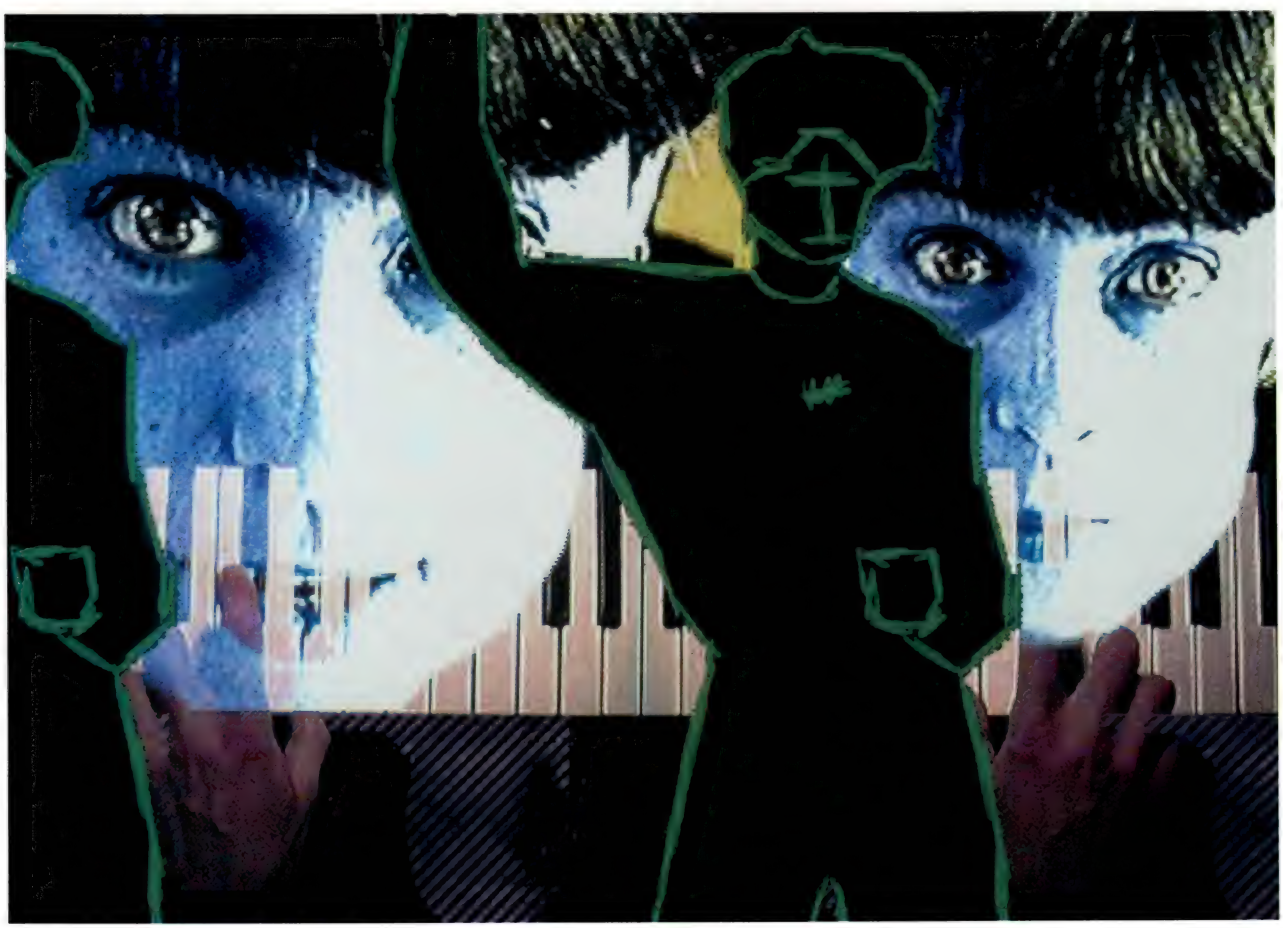
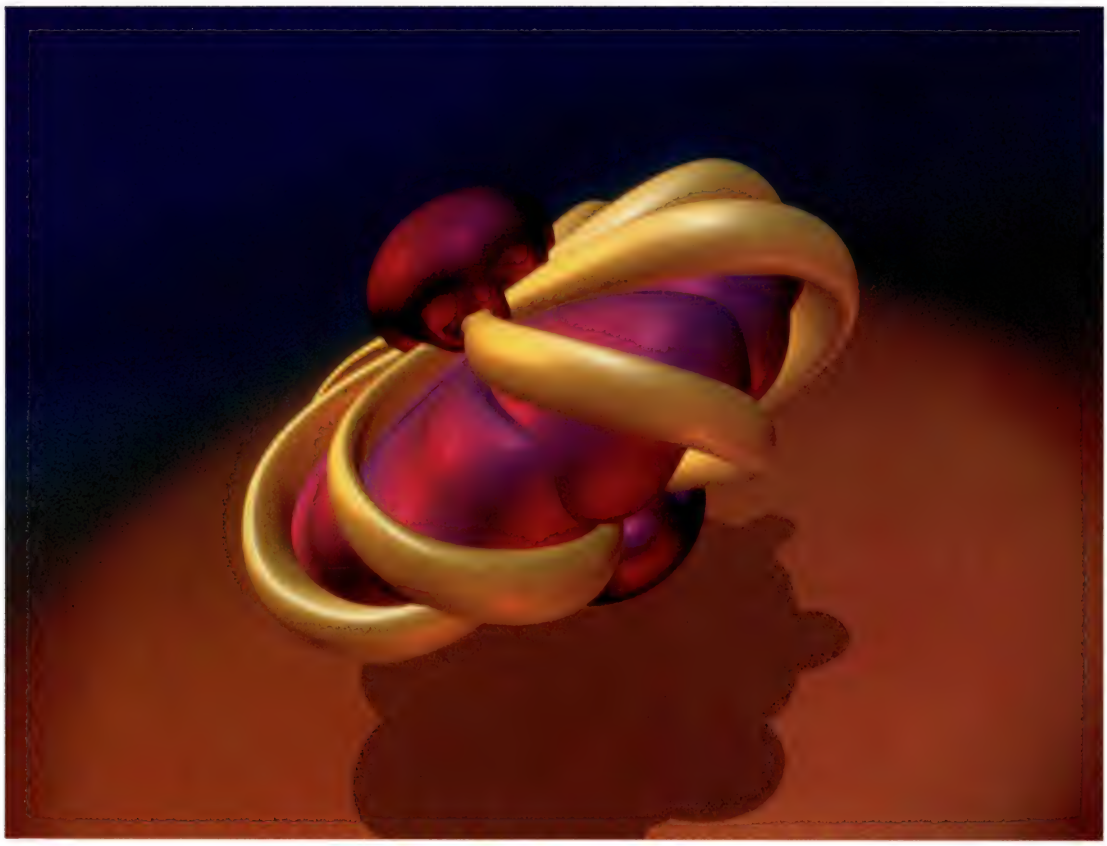
Animation, Video, and Music:
Stuart Sharpe





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SOFTWARE
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Master Illusionist: Nathaniel Thurston
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Animation: David Ben-Zvi, Daeron Meyer
Additional Animation: Adam Deaton, Dan Krech, Matt Headrick, Mark Phillips
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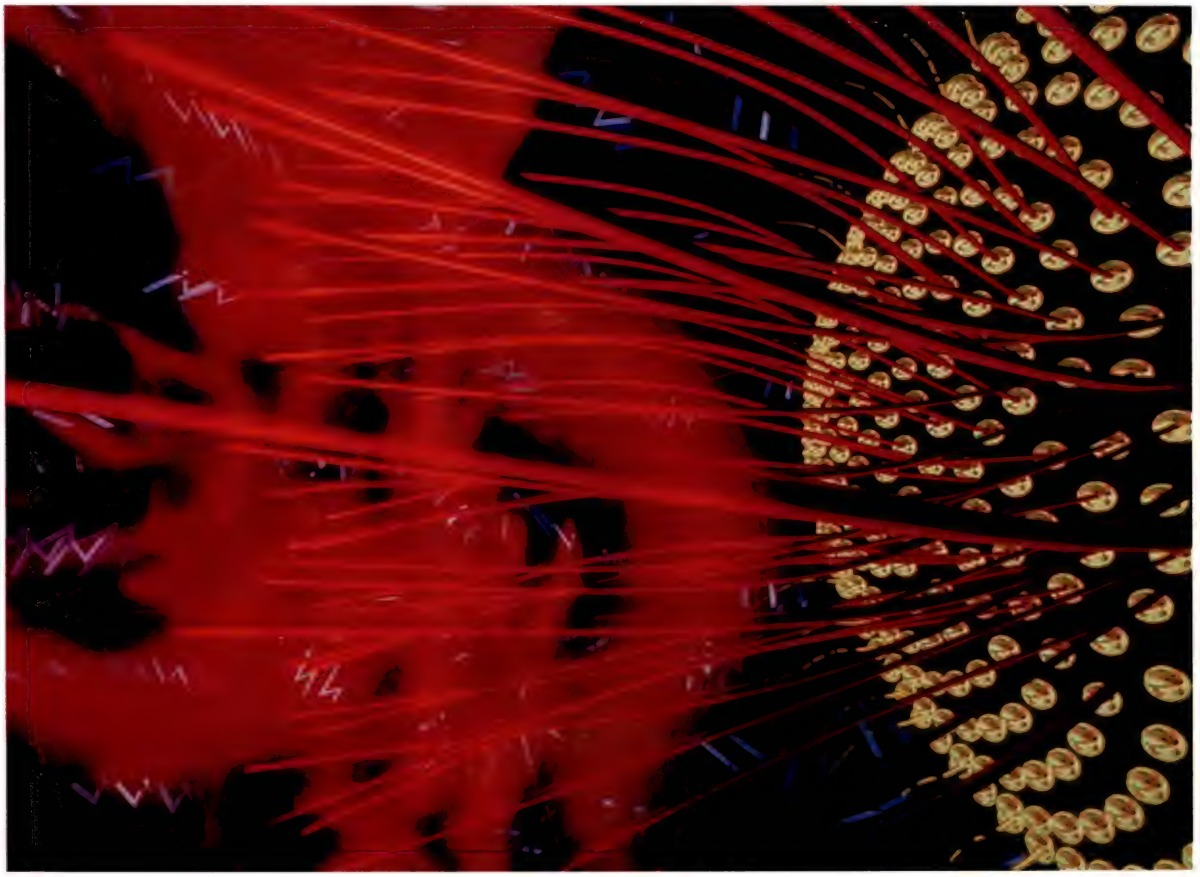
Still Images: George Francis
Audio Post-Production, Sound Design, & Mix: Hudson-Forrester Studios, Inc.
Narration: Karen McNenny, Paul de Cordova
Video Post-production: Lamb & Company
Video Editing: Audrey Robinson
Video Technical Assistance: Scott Gaff
Sponsor: National Science Foundation, Department of Energy, University of MInnesota, Minnesota Technology Inc.



Stereoscopic HDTV

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SOFTWARE
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SGI

SOFTWARE
Rhythm & Hues proprietary

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Art Director: Lorne Lanning
Computer Graphics Supervisor: Kathy White
Animation Director: Charlie Gibson
Special Effects Supervisor: Lorne Lanning, Larry Weinberg
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Digital Cinematography, Creatures: Min
Creature Animation: Larry Weinberg
Animators: Colin Brady, Darrin Butts, Nancy Kato, Robert Lurye, Suponwich Somsaman, Steve Ziolkowski
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Production Manager: John Hughes
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Chuck W. Gamble

HARDWARE
Macintosh

SOFTWARE
Macromedia Director

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Special thanks to: Erik Timmerman, Laura Gygi-Gamble, Bob Mickschl, my parents

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SOFTWARE
SOFTIMAGE

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They Are Here!
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SOFTWARE
Digipix

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Animator: Alec Knox
Software: Simon Robinson
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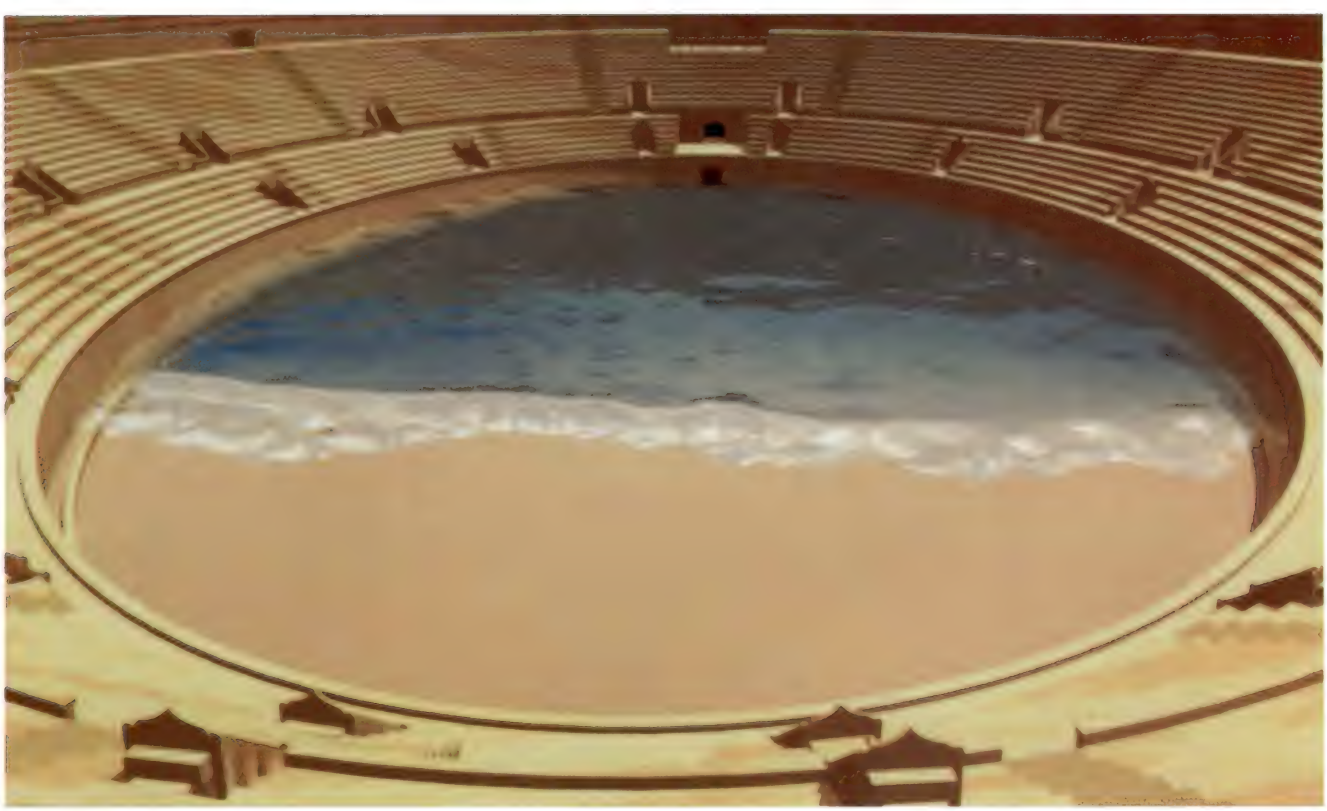
Designer: Iain MacDonald



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Director of Photography:
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Gemma Barcenilia
Post-Production:
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Capturing Weldon Pond

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Special Thanks: Kevin Landel, Mike Bailey, Todd Elvins, Holliday Horton
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Carefree Gum 'Bursting Bubbles'

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Writer: Scott Rosenblit
Music: Mickey Petralia, Greg Kuehn
Sound: Mitch Raboy, Superdupe
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Software: proprietary

Cell Quakes

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Software: custom; Explorer; Adobe Photoshop

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Crystal Paradise

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Hardware: SGI
Software: SOFTIMAGE, UnReal

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Producer: David W. Deerfield II
Researchers: Yong Duan, Shankar Kumar, John Rosenbery, Peter Kollman
Animation: David W. Deerfield II, Joseph C. Lappa, Gregory Foss, A. Marcela Madrid
Hardware: Cray C90, SGI Crimson
Software: Amber; In-house

Electro-Magnetic Distributions in an Induction Motor

Hideo Yamashita
Electric Machinery Laboratory
Hiroshima University
1-4-1 Kagamiyama
Higashi-Hiroshima 724
JAPAN
+81.824.24.7665
+81.824.22.7195 fax
yama@eml.hiroshima-u.ac.jp

Producer: Hiroshima University, Electric Machinery Lab
Directors: E. Nakamae, H. Yamashita
Music: H. Iriyana
Programmers: K. Kaneda, K. Nakao, H. Kanetani, A. Namera, K. Kamei
Hardware: SGI, Toshiba Hi-vision CG Recording System
Software: SOFTIMAGE; in-house

ETB 2 Station identity

José Muniain
Ostra Delta, S.A.
Don Ramón de la Cruz, 75-1ºA
28001 Madrid
SPAIN
+34.1.401.88.00
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Producer: José Muniain
Post Production: Telson, S.A.
Art Direction: Juan Delcan
Direction: Patrick Rouchon
Production: José Muniain
Hardware: SGI, Quantel
Software: TDI Explore

FURBLE

Yasuo Ohba
Namco Ltd.
16th Floor
New Stage Yokohama Building
1-1-32, Shin-Urashima-cho
Kanagawa-ku, Yokohama 221
JAPAN
+81.4.5461.8032
+81.4.5461.8098 fax

Producer: Yasuo Ohba
Animator/Technical Director: Yasuo Ohba
Music: Namco
Hardware: SGI Indigo2 Extreme
Software: Hairy Animation Rendering System (FURBLE)

Galactic Cannibalism: IMAX Test Video of Colliding Galaxies

Donna J. Cox
NCSA
University of Illinois
at Urbana-Champaign
605 East Springfield Avenue
Champaign, IL 61820
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+1.217.244.1987 fax
dcox@ncsa.uiuc.edu

Producer: Amanda Ronai
Contributors: Donna J. Cox, Robert Patterson, Mike McNeill, Mike Norman, Richard Gerber, Bayley Silleck, Martin Harwitt
Music: Scott Wyatt
Hardware: SGI
Software: In-house; Wavefront

Heart and Souls

Monica Corbin
Pacific Data Images
650 North Bronson Avenue, 400 W
Los Angeles, CA 90004 USA
+1.213.960.4042
+1.213.960.4051 fax

Producers: Jennifer Bell, Dan Chuba, Michele Ferrone, Doug Nichols
Executive Producers: John Swallow, Carl Rosendahl
Visual Effects Supervisor: Jamie Dixon
Art Director: Carlos Arguello
Technical Director: Wendy Rogers
Animation Supervisors: Andrew Adamson, Rebecca Marie
Lead Animator: Barbara Meier
Animators: Ken Bielenberg, Adam Chin, Aliza Corson, Kevin Rafferty, Amie Slate, Lisa Suzuki
Assistant Animators: Al Arthur, Mary McCulloch, Michael Meckler, Ira Shain, Lea Zagury
Production Manager: Barbara McCullough
Digital I/O Supervisor: Tom Martinek
Visual Effects Editor: Kelly Tartan
Film Recordists: Mark Dinicola, John Hanashiro
Software Development: Thaddeus Beier, Rod Bogart
Hardware: SGI
Software: proprietary

Hurricane Gilbert

Bill Hibbard
Space Science
and Engineering Center
1225 West Dayton St.
Madison, WI 53706 USA
+1.608.263.4427
+1.608.263.6738 fax
whibbard@macc.wisc.edu

Producer: Bill Hibbard
Contributors: Brian Paul,
Greg Tripoli, Peter Pokrandt,
Bill Gray, Tom Wittaker
Hardware: SGI 340 VGX
Software: VIS-5D

Impact of Comet Shoemaker-Levy 9 on Jupiter: The First 40 Minutes

Anjana Kar
Pittsburgh Supercomputing
Center
Mellon Institute Building
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Pittsburgh, PA 15213 USA
+1.412.268.4960
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kar@psc.edu

Producer: Joel Welling
Contributors:
Mordecai-Mark Mac Low,
University of Chicago
Kevin Zahnle,
NASA Ames Research Center
Hardware: Cray C90
Software: Hydrocode Zeus-3D;
in-house

Koa La Grenouille/InsektorS

Georges Lacroix
Fantôme
51 rue Pierre
92110 Clichy
FRANCE
+33.1.47.37.27.27
+33.1.47.37.55.96 fax

Producer: Fantóme Animation
Contributors: Canal+, France 3,
RTBF/IMAGIQUE, NEURONES
CARTOON, LUXANIMA,
Club D'Investissement Media
avec la participation du Centre
National de la Cinematographie
La Grenouille
Design: Danoel Huerrier avec
l'aimable autorisation de
Service Plus/BBC
Hardware: SGI
Software: Explore; Wavefront;
SOFTIMAGE

La Victoria 'Mind of Their Own'

Monica Corbin
Pacific Data Images
1111 Karlstad Drive
Sunnyvale, CA 94089 USA
+1.408.745.6755
+1.408.745.6746 fax

Producers: Carole Ferrari,
Michael King
PDI Director: Tim Johnson
Technical Director:
Ray Giarratana
Animator: Raman Hui
Agency: DDB Needham
Creative Director:
Rick Carpenter
Copywriter: Rick Monteiro
Production Co.: Coppos Films
Executive Producer:
Bill Bratkowski
Director: Brent Thomas
Art Director: Jack Wright
Director of Photography:
Stephen Ramsey
Hardware: SGI
Software: Proprietary

'M. Butterfly' Title Sequence

Michael Arias
Syzygy Digital Cinema
230 West 17th Street
New York, NY 10011 USA
+1.212.627.3430
+1.212.989.6528 fax
syzygy@panix.com

Producer: Syzygy Digital Cinema
in association with Balsmeyer
and Everett, Inc.
Director: Randall Balsmeyer
Computer Graphics
Supervisor/Animator:
Michael Arias
Design: Randall Balsmeyer,
Mimi Everett
Line Producer: Kathy Kelehan
Computer Graphics Artists:
Brett Gardy, Daniel Leung,
Rachel Cohen
Research: Jennifer Sherman
Hardware: SGI Indigo, Macintosh
Quadra, Management Graphics
Software: Solitaire Cine,
Animal Logic Eddie, Adobe
Photoshop, Xaos nTitle,
proprietary

Mandarina Duck-Missing My Girl

Victor Wong
Menfond Elec. Art & Computer
Design Co. Ltd.
B & C 18 Floor Lockhart Centre
301-307 Lockhart Road
Wanchai
HONG KONG
+852.802.3382
+852.802.3386 fax

Producer: Victor Wong
Director: Victor Wong
Computer Animation Director:
Eddy Wong
Production Producer:
Thalia Wong
Hardware: SGI Indigo
Software: SOFTIMAGE Creative
Environment, Eddie Compositor

Memory

Katsuhiko Hayashi
NHK Creative, Inc.
NHK/The Human Brain and
Mind Project
Shibuya
Tokyo 150-01
JAPAN
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+81.3.3468.0979 fax

Producer: Yoshiko Nakagawa
Music: Joe Hisaishi
Hardware: SGI Indigo Elan
Software: Personal Links

Metamorfosi

Piero Cecchini
Global Design
C 50 P.TA Romana 6
20122 Milan
ITALY
+39.2.8940.6298
+39.2.8940.6356 fax

Producer: Marco Poma
Art Director: Piero Cecchini, Giõ Talarico
Computer Animation: Piero Cecchini
Music: Maurizio Marsico
Hardware: SGI
Software: Xaos Pandemonium, nTitle; SOFTIMAGE

Mirage Illimité

Maurice Benayoun
Z. A Production
64, rue de la Folie Méricourt
75011 Paris
FRANCE
+33.1.48.06.65.66
+33.1.48.06.48.75 fax

Producer: Maurice Benayoun
Contributors: Z. A Production, Grand Canal, Mikros
Hardware: SGI
Software: SOFTIMAGE

Mistaken Identity

Brian Steiner
Ringling School of Art and Design
2700 North Tamiami Trail
Sarasota, FL 34234
+1.813.359.7573
+1.813.359.7517 fax

Producers: Brian Steiner, Timothy Keon
Hardware: SGI Indigo xs24
Software: Wavefront Advanced Visualizer

Monster Party

Valerie Hallier
445 West 19th Street, #4G
New York, NY 10011 USA
+1.212.592.2538
+1.212.592.2509 fax

Producer: Valerie Hallier
Music: Curtis Watts
Hardware: SGI Indigo xs24
Software: TDI Explore 3.01

Mount Redoubt Volcano Eruption

Mitchell Roth
Arctic Region Supercomputing Center
University of Alaska
101 Bunnell Hall
Fairbanks, AK 99775-6020 USA
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+1.907.474.5494 fax
roth@acad5.alaska.edu

Producer: Mitchell Roth
Contributors: Rick Guritz, Mark Astley, Greg Johnson, Steve Jones, Jon Warwick
Hardware: Cray Y-MP, SGI
Software: AVS

Move

Keith Cormier
Lamb & Company
650 Third Avenue South
17th Floor
Minneapolis, MN 55402 USA
+1.612.333.8666
+1.612.333.9173 fax
keith@lamb.com

Producer: Keith Cormier
Contributors: Gayle Ayers, Mark Mariutto, Keith Cormier, Doug Sutton, Doug Kingsbury, Jeff Thingvold
Hardware: Ascension Technology Flock of Birds, SGI
Software: Wavefront Advanced Visualizer, Dynamation; Pixar RenderMan

Moving

Xavier Nicolas
Ex Machina
22, rue Hegesippe Moreau
75018 Paris
FRANCE
+33.1.44.90.1190
+33.1.44.90.1191 fax

Producers: Ex Machina, Big Heart Film: Pascal Roulin
Music: Celmar Engel
Computer Graphics: Ex Machina
Hardware: SGI
Software: Explore

Mr. Sticky Bubble Gum

Alex Tysowsky
Ringling School of Art and Design
2700 North Tamiami Trail
Sarasota, FL 34234 USA
+1.813.359.7574
+1.813.359.7517 fax

Producer: Alex Tysowsky
Hardware: SGI
Software: SOFTIMAGE

MRI Face Mask

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National University of Singapore
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Kent Ridge
Singapore 0511
REPUBLIC OF SINGAPORE
+1.65.772.6743
+1.65.778.2571 fax
meiyap@iss.nus.sg

Producers: S. Meiyappan and Pheng Ann Heng
Produced/Directed by: S. Meiyappan, Pheng Ann Heng
Visualization/Animation Software: S. Meiyappan
Support: Raghu Raghavan, Tim Poston, Wieslaw Nonwinski
Technical Assistance: Geoff Nicholas, Chui Chee Kong
Hardware: SGI
Software: in-house

NASA/JSC Excerpts

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Taft Broadcasting Company/NASA JSC
NASA Johnson Space Center
JL5
Houston, TX 77058 USA
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marco@miranda.jsc.nasa.gov

Producer: Marco Zambetti
Contributors: Marco Zambetti, Gary Rogers, Dexter Herbert, Laura Cole
Hardware: SGI
Software: Wavefront Advanced Visualizer, Dynamation

Nestle: Old Woman

Sylvain Taillon
Topix Computer Graphics & Animation
567 Queen Street West
Toronto, Ontario M5V 2B6
CANADA
+1.416.364.6444
+1.416.364.2539 fax

Producer: Sylvain Taillon
Animation Director: William Cameron
Animator: Aaron Weintaub
Hardware: SGI
Software: Flint; Topix Tools

Nick Boy

Cindy E. Brolsma
Blue Sky Productions, Inc.
100 Executive Boulevard
Ossining, NY 10562 USA
+1.914.941.5260
+1.914.923.9058 fax
cindy@bluesky.jpr.com

Producer: Alison Brown
Agency: Nickelodeon
Producer: Agi Fodor
Creative Director: Scott Webb
Director/Designer: Chris Wedge
Technical Director: Oliver Rockwell
Animator: Chris Wedge
Music: Pomposello Productions
Hardware: Sun, SGI, HP
Software: CGI Studio; SOFTIMAGE

Oat Revolt

Carol Taylor
Editel
301 East Erie
Chicago, IL 60611-3039 USA
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+1.312.440.1541 fax

Producer: Tom Dadras
Directors of Animation: Tom Dadras, Ed Newmann
3D Animators: William Opdyke, Kenneth McAll
Paintbox/Harry Artists: Glen Noren, Steven Lau, Marko Markewycz
Colorist: Ron Anderson
D1 Composite Editor: Jeff Heusser
Cel Animation: Monica Kendall (Calabash Animation)
Hardware: SGI
Software: Wavefront

Oscillation

Jules Bister
Atelier Bister Animation Art
Ludolfstrasse 42
20249 Hamburg
GERMANY
+49.40.46.18.58
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Producer: Atelier Bister Animaton Art
Contributor: Jules Bister
Hardware: SGI 4D/35, Indigo
Software: SOFTIMAGE 4D Creative Environment

Outside In

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The Geometry Center
University of Minnesota
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munzner@geom.umn.edu

Producers: Silvio Levy, Delle Maxwell, Tamara Munzner
Concept: Bill Thurston
Direction & Animation: Silvio Levy, Delle Maxwell, Tamara Munzner
Master Illusionist: Nathaniel Thurston
Technical Shepherd: Stuart Levy
Animation: David Ben-Zvi, Daeron Meyer
Additional Animation: Adam Deaton, Dan Krech, Matt Headrick, Mark Phillips
Technical Contributions: Celeste Fowler, Charlie Gunn, Stephanie Mason, Linus Upson, Scott Wisom
Written by: David Ben-Zvi, Matt Headrick, Silvio Levy, Delle Maxwell, Tamara Munzner, Bill Thurston
Still Images: George Francis
Audio Post-Production, Sound Design: Hudson-Forrester Studios, Inc.
Narration: Karen McNenny, Paul de Cordova
Video Post-Production: Lamb & Company
Video Editing: Audrey Robinson
Video Technical Assistance: Scott Gaff
Sponsors: National Science Foundation, Department of Energy, University of Minnesota, Minnesota Technology Inc.
Hardware: SGI
Software: Custom, RenderMan, SOFTIMAGE, Mathematica, Geomview, Perl

Plastic Operation

Yuji Furuta
Taiyo Kikaku Corp.
2-26-3 Nishishinbashi
Minato-ku
Tokyo
JAPAN
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Producer: Yuji Furuta
Hardware: NEWS 3870, 5000
Software: Original Software

Pump Up the Volume

Anjana Kar
Pittsburgh Supercomputing Center
Mellon Institute Building
4400 Fifth Avenue
Pittsburgh, PA 15213 USA
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+1.412.268.5832 fax
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Producer: Phil Andrews
Animation: Gregory Foss
Software Support: Grace Giras
Researchers: David M. McQueen, Charles S. Peskin
Hardware: SGI Crimson
Software: SOFTIMAGE

RACOON

Bruno Simon
Renault Design SLE 1602
860, Quai De Stalingrad
92109 Boulogne Billancourt
Cedex
FRANCE
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simon@renault.renault.fr

Producer: Bruno Simon
Software: STV – Synthetic TV - I.N.A., Wavefront, Explore

Rain

Hideo Yamashita
Hiroshima University
1-4-1 Kagamiyama
Higashi-hiroshima 724
JAPAN
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+1.81.824.22.7195 fax
yama@eml.hiroshima-u.ac.jp

Producer: Hideo Yamashita
Director: Kazufumi Kaneda
Programmers: Takushi Kagawa, Yasuhiko Zuyama
Hardware: SGI
Software: RainRay

Rave Safe

Adem Jaffers
NUAA
3/137 Domain Rd.
South Yarra
Melbourne, Victoria 3141
AUSTRALIA
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+1.61.3.696.1206 fax
mandala@suburbia.apana.org.au

Producer: Emerald Films
Director: Jeff Jaffers
2D animation: Jeff and Adem Jaffers
3D animation: Adem Jaffers
Music: Third Eye
Producer: Tracy Walsh
Hardware: Amiga
Software: Opalpaint, DPaint, Morphplus, Imagine, DigiView

Reaching the Light

Yina Chang
Advanced Computing Center for the Arts & Design
The Ohio State University
1224 Kinnear Road
Columbus, OH 43212 USA
+1.614.292.3416
+1.614.292.7776 fax
yina@cgrg.ohio-state.edu

Producer: Yina Chang
Animation Software: John Donkin, Steve Spencer
Modeling Software: Steve Spencer, John Donkin
Rendering Software: Scott Dyer, Steve May
Image Processing Software: Jeff Light, Peter Carswell
Model Building: Gigi Alandt
Special Purpose Software: John Donkin
Technical Advisory: Chitra Shriram
Editor: Brad Coop
Music: Victor Alexeeff, Mark Snider
Produced at: The Advanced Computing Center for the Arts and Design, The Ohio State University, and Mills/James Productions
Hardware: Sun/Sparc, SGI/Indigo, Macintosh, Macrotek Scanner, Abekas
Software: in-house

Real-Time Volume Rendering of Downbursts

Bill Hibbard
Space Science and Engineering Center
1225 West Dayton Street
Madison, WI 53706 USA
+1.608.263.4427
+1.608.263.6738 fax
whibbard@macc.wisc.edu

Producers: Bill Hibbard and Brian Paul
Contributors: Bill Hibbard, Brian Paul, John Anderson, Leigh Orf
Hardware: SGI Onyx RE
Software: VIS 5D

Sci-Fi Channel 'Expedition'

Linda Jones
Xaos Inc.
600 Townsend Street, Suite 271E
San Francisco, CA 94103 USA
+1.415.558.9267
+1.415.558.9160 fax
marie@xaos.com

Producer: Xaos, for Aerodrome Pictures & Sci-Fi Channel
Art Directors/Animators: Hayden Landis, Henry Preston
Animators: Roberta Brandao, Cassidy Curtis, Chitra Shriram
Software Support: Derek Bolski, Cassidy Curtis, Eric Texier
Creative Director: Mark Malmberg
Director: R. Scott Miller, Aerodrome Pictures
Hardware: SGI
Software: Xaos proprietary

Scuba Dog

Bob Mazza
Boss Film Studios
13335 Maxella Avenue
Marina del Rey, CA 90292 USA
+1.10.823.0433
+1.310.305.8576 fax

Producer: John Clinton
Story, Designer, Director: Roger L. Gould
Animators: Mike Fleming, Walt Hyneman, Ken King, Peter Lepeniotis, David Smith, Mitchell Rosefelt
Painter: Michele Moen
Storyboard: Howard Baker
Additional Design: John Mann
Additional Models: Chris Roda, Marc Toscano
Creative Director/Founder Boss Film: Richard Edlund
Production Supervisor: Ellen Somers
CGI Supervisor: Jim Rygiel
Music: Michael Stearns
Sound Effects: John Morris
Post Effects: The Digital Lab Inc.
Hardware: SGI
Software: Wavefront; Matador Paint; Alias Modeller; Symbolics

Sextuor

Pierre Henon
A.i.i-ENSAD
31 rue d'Ulm
75005 Paris
FRANCE
+1.33.1.4326.3635
+1.33.1.4046.8154 fax
henon@ensad.fr

Producer: A.i.i-ENSAD
Hardware: SGI
Software: Explore TDI

Smarties 'Smart-I-LLusions'

Sara Hayes
The Mill
40/41 Great Marlborough Street
London W1V 1DA
UK
+1.44.71.287.4041
+1.44.71.287.8393 fax

Producer: Alistair Fryer
Agency : JWT
Production Company: Richard Purdum Prooductions
Directors: Richard Purdum, Michael Dudok De Wit
Producer: Jill Thomas Post
Production Company: The Mill
3D Animation : Linda Johnson
Harry : Tony Lawrence
Hardware: SGI Indigo, Quantel Harry
Software: SOFTIMAGE

"SOUL. [placed] beyond glass"

Jason Barlow
Visualization Laboratory
College of Architecture
Texas A&M University
College Station, TX 77843 USA
+1.409.845.3465
+1.409.845.4491 fax
jason@viz.tamu.edu

Producer: Jason Barlow
Contributors: viz lab students, Rebecca Garza
Hardware: SGI, Sierra Design Labs
Software: Xaos Tools; SOFTIMAGE Eddie

Sugar Crisp: Tour

Stephen Price
Topix Computer Graphics & Animation
567 Queen Street West
Toronto, Ontario M5V 2B6
CANADA
+1.416.364.6444
+1.416.364.2539 fax

Producer: Stephen Price
Animation Director: John Mariella
Animators: Frank Falcone, Doug Masters
Modeling: Koichi Noguchi
Compositing: Jim Cooper
Hardware: SGI
Software: SOFTIMAGE; Topix Tools

Tableau D' Amour

Beriou
Agave S.A.
Cap 108
67, rue Robespierre
93558 Montreuil Cedex
FRANCE
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+1.33.1.48.57.07.77 fax

Producers: Agave S, Canal, Club d'Investissement Media
Direction: Beriou
Modeling Assistants: Daniel Barthelem, Oliver Debert, Pascal Jonquais
Sound Track: Gilles Fournier
Computer Technology: Gilles Bollaert
Hardware: Hewlett Packard
Software: Synthetic Video 4

Techno Digesto Fetishism

Troy Innocent
10 McCubbin TCE
East Doncaster
Melbourne, Victoria 3109
AUSTRALIA
+1.61.3.696.4388
+1.61.3.696.4626 fax
troy@empire.com.au

Producers: Troy Innocent, Elena Popa
Hardware: Macintosh Quadra, AVID Media Suite Pro
Software: Macromedia Director 3.1, CoSA After Effects 2.0, Adobe Photoshop 2.5,Paint Alchemy, Electric Image 1.5, Presenter Professional

The Adventure of Peter Pan 2

Kouichi Tashiro
Namco Ltd.
New Stage Yokohma Building
1-1-32 Shin-Urashima-Chou
Kangawa-Ku, Yokohama 221
JAPAN
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+81.5461.8098 fax

Producer: Kazumichi Kiyono
Executive Producers: Kazunori Sawano, Kouichi Tashiro
Animation Producers: Shigeo Endo, Akio Yogo
CG Producers: Nob Hosoda, Kazumichi Kiyono, Hiroshi Yamagata
CG Director: Isao Nakayama
Animation Director: Satoshi Hanai
Technical Engineer: Takashi Kitaizumi
Animation Paint/Editing Composite: Yoshio Kuroda, Hidenori Nakamura
Animation Production Manager: Masahiko Kobayashi
CG Production Manager: Masa Morisugi
CG Animators: Isao Nakayama, Hiroshi Fujiwara, Tetsuya Kanakubo, Chiaki Shimizu
Sound: Sound Effects System Inc.
Hardware: SGI 4D, ONYX
Software: in-house

The Fall

Amanda Ronai
Visualization Lab
Texas A&M University
216 Langford Center
College Station, TX 77843-3137
USA
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amanda@viz.tamu.ed

Producer: Amanda Ronai
Hardware: SGI
Software: SOFTIMAGE; UnReal

The First Flower People

Katsuhiko Hayashi
NHK Creative, Inc.
NHK/The Human Brain and Mind Project
Shibuya
Tokyo 150-01
JAPAN
+1.81.3.3481.1699
+1.81.3.3468.0979 fax

Producer: Naoko Motoyoshi
Designers: Mitsuko Nakano, Michinobu Tanaka
Music: Joe Hisaishi
Hardware: SGI Indigo Elan, SDS480 (Shima Seiki), Macintosh Quadra.
Software: Wavefront, Photoshop

The Hit

Jordi Moragues
Universitat De Les Illes Balears
Can. Valldemossa, Km 7.5
Edifici Anselm Turmeda Campus UIB
07071 Palma de Mallorca
SPAIN
+1.34.71.173201
+1.34.71.173003 fax

Producer: Universitat De Les Illes Balears
Hardware: SGI
Software: Explore TDI

The Loch Ness Expedition

Jayne Anderson
Evans & Sutherland Computer Corporation
600 Komas Drive
Salt Lake City, UT 84108
+1.801.582.5847
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Hardware: ESIG 2000 Real-Time Image Generator
Software: EaSIEST Database Modeling Software.

They Are Here! (The Quarxs) Extract

Maurice Benayoun
Z.A Production
64, rue de la Folie Méricourt
75011 Paris
FRANCE
+1.33.1.48.06.65.66
+1.33.1.48.06.48.75 fax

Producer: Z.A. Production
Contributors: Canal+, France 3, Ellepse, Club D' Investissement Media
Hardware: SGI
Software: SOFTIMAGE

Uncle Louie's Obedience School

Jeff Pratt
Ringling School of Art and Design
2700 North Tamiami Trail
Sarasota, FL 34234
+1.813.359.7574
+1.813.359.7517 fax

Producer: Jeff Pratt
Hardware: SGI
Software: SOFTIMAGE

URSA MINOR BLUE

Kaoru Matsuzaki
HD Video Software Center
Sony Corporation
6-7-35 Kitashinagawa,
Shinagawa-ku
Tokyo 104
JAPAN
+1.81.3.5448.2125
+1.81.3.5448.4244 fax

Producers: Tomiyo Hiruta, Mitsuo Shionaga, Kaoru Matsuzaki
Written, adapted, illustrated & directed by: Shigeru Tamura
Production Supervisor: Mitsuo Shionaga
Music: Utollo Teshikai
Animation Design & Computer Programming: Drycima
HD Technical Engineer: Hitoshi Fukudome
Executive Producers: Megumi Sugiyama, Shohachi Sakai
Hardware: Macintosh Quadra 700, 900, NAC Hypergraphy
Software: MacroMind Director, Accelerator, Studio 8, Super Paint

Virtual Reality in Computational Neuroscience

Jason Leigh
Electronic Visualization Lab
University of Illinois at Chicago
P.O. Box 4348, M/C 154
Chicago, IL 60680 USA
+1.312.996.3002
+1.312.413.7585 fax
spiff@bert.eecs.uic.edu

Producer: Jason Leigh
Contributors: Jason Leigh,Thomas A. DeFanti, Chris Assad, Brian Rasnow, Alex Protopappas, Erik De Schutter, James M. Bower
Hardware: SGI Indigo xs24
Software: proprietary 'V' VR interface library

Visualization of Stratospheric Ozone and Atmospheric Dynamics

Lloyd A. Treinish
IBM T. J. Watson Research Center
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+1.914.784.5130 fax
lloydt@watson.ibm.com

Producer: Lloyd A. Treinish
Hardware: IBM Power Visualization System
Software: IBM Visualization Data Explorer

Wild Flavors

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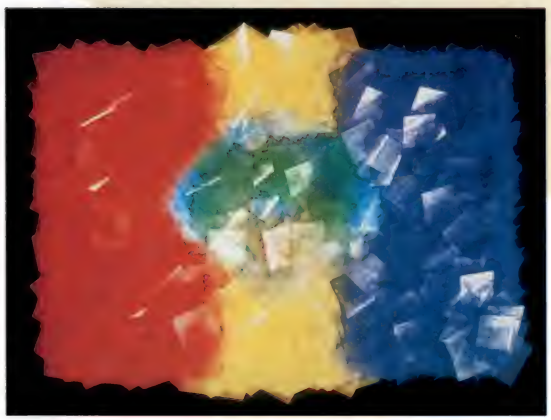
Blue Sky Productions, Inc.
100 Executive Boulevard
Ossining, NY 10562 USA
+1.914.941.5260
+1.914.923.9058 fax
cindy@bluesky.jpr.com

Producer: Nina Rappaport
Client: DDB Needham
Producer: Walter Brindak
Copywriter: Jane Talcott
Art Director: Tony Romeo
Client: Hershey
Director: Jan Carlee
Technical Director: Sam Richards
Animator: Carlos Saldanha
Modeling: Carlos Saldanha
Production Support: Cliff Bohm, Alex Arce, Sandy Turoff, Peter Carisi De Lappe
Live Action: Young & Co.
Producer: T.J. Beagan
Director: Eric Young
Hardware: Sun, SGI, HP
Software: CGI Studio, SOFTIMAGE



Deanna Morse
Art and Design Show Chair

I N T R O D U C T I O N

Welcome to the SIGGRAPH 94 Art and Design Show.

The SIGGRAPH 94 Art and Design Show continues the tradition of showcasing a survey of the best recent works in art, design, and animation. The show is broad-based and media-inclusive. We considered entries in fine arts, design, interactive installations, art-based or multimedia essays, and animation. The 94 show includes site-specific works, shown outside of a gallery setting. We also produced an Art and Design Show video, "Persistence of Vision" with jurors' comments to place the work in a context.

We see some themes in the works this year. Several of the pieces represent a search for cultural roots. Some reflect the experience of being a tourist. Several look at family and memories. There were works that interspersed reality and fantasy elements. Some are obviously playful. There were a few with overt political statements. Many of the pieces considered the human form, and several were self-portraits. The animations included a number of collage pieces, and stories or story fragments.

As with all art, this show challenges our perspectives, stretches the limits of the expected, embraces change, and considers the meaning of visual language, codes, and symbols. Unlike many art shows, this one comments on the present because all of these artists are working with "tools" that were invented during their lifetimes.

As specified in our call for participation, the primary criterion for acceptance was aesthetic. Each work was evaluated with "traditional fine arts" considerations: use of compositional elements, color, line, form and tone. In addition, the jurors considered the aesthetic intention of each, judging the artworks on what we felt the artist was trying to achieve. We selected works that approached artistic design and creation in original ways. We looked for work that would challenge our perspectives. We included art that was visually exciting or had a strong emotional content.

We asked for works that could not have been created without the wide variety of computer tools that artists use today. As computer-generated works, the art bears the mark of the media that assisted with its creation. Some works are graphic displays of mathematical concepts. In these, the computer has determined a distinctive appearance, a syntax, that makes the work easily recognizable as computer art. In other works, where the artist has used the tools for more traditional artistic intention, these marks are less obvious. In many of the interactive works, the computer serves another function. By redefining the relationship between the viewer and the art, the computer serves as a medium as well as a tool.

Within SIGGRAPH, the Art and Design Show is one of the few places where individual voices are expressed through technology. Much of computer graphics work is collaborative, and here is one opportunity to consider the statement of a single artist. Unlike most of the conference, this art is not intended to be in the service of commercialism. Instead it offers comment on the role of technology in society today.

The competition was keen. Through a "blind" jury process, in which the jurors were not told the names of the artists, approximately 100 pieces were selected. The jurors for the 2D and 3D works were:

Young Harvill, artist, software designer and Fellow
Macromedia, San Francisco

Isaac Victor Kerlow, author, designer and Chair
Computer Graphics Department
Pratt Institute, Brooklyn

Barbara London, Associate Curator
Museum of Modern Art, New York

Joan Truckenbrod, artist, author and Chair, Time Arts Department
School of the Art Institute of Chicago, Chicago

With input from the Electronic Theater jurors, I selected the art show animations.

We hope that you are engaged by this artistic experience.

Deanna Morse
Chair, SIGGRAPH 94 Art and Design Show

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Allendale, MI 49401

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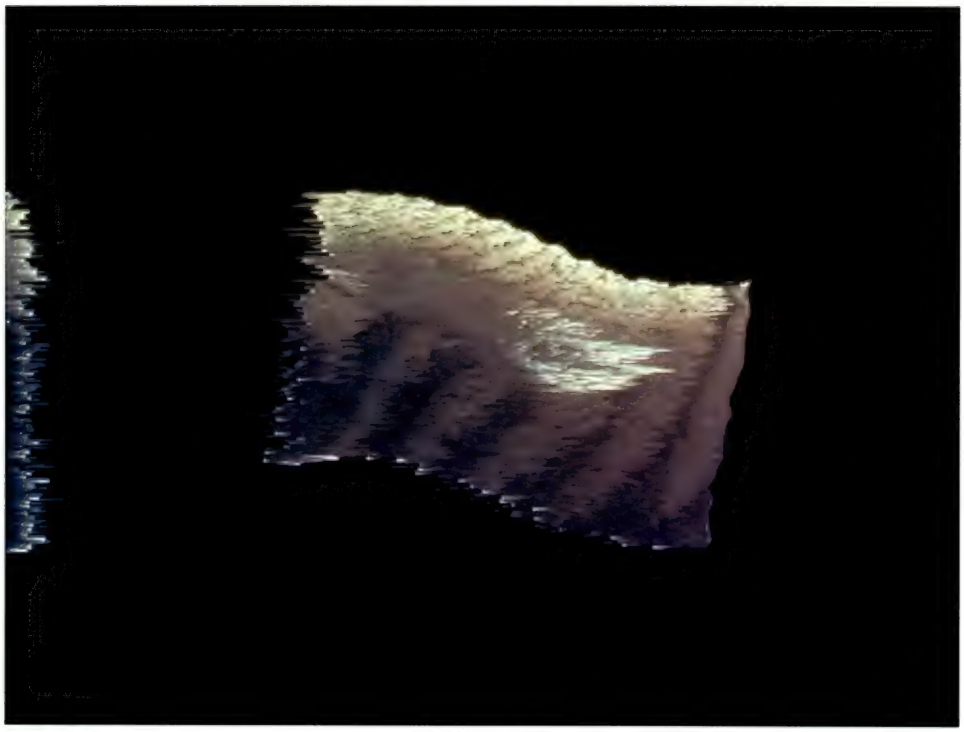
email morsed@gvsu.edu

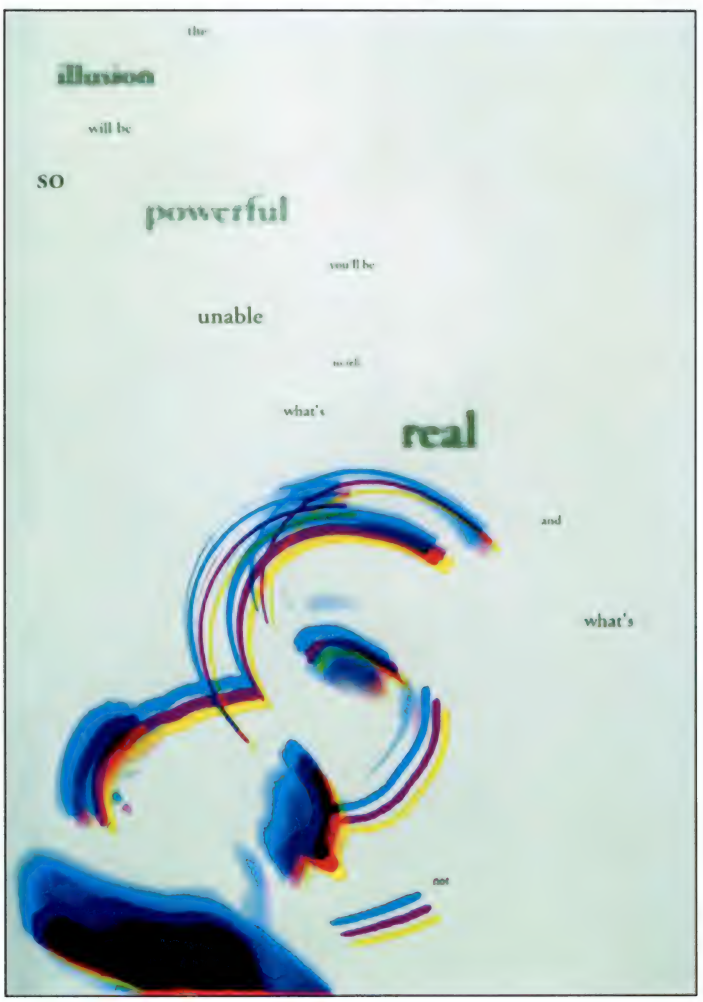


Frances Valesco
Fish #9 | 1993

Inkjet on rag paper
8.5 x 11 inches

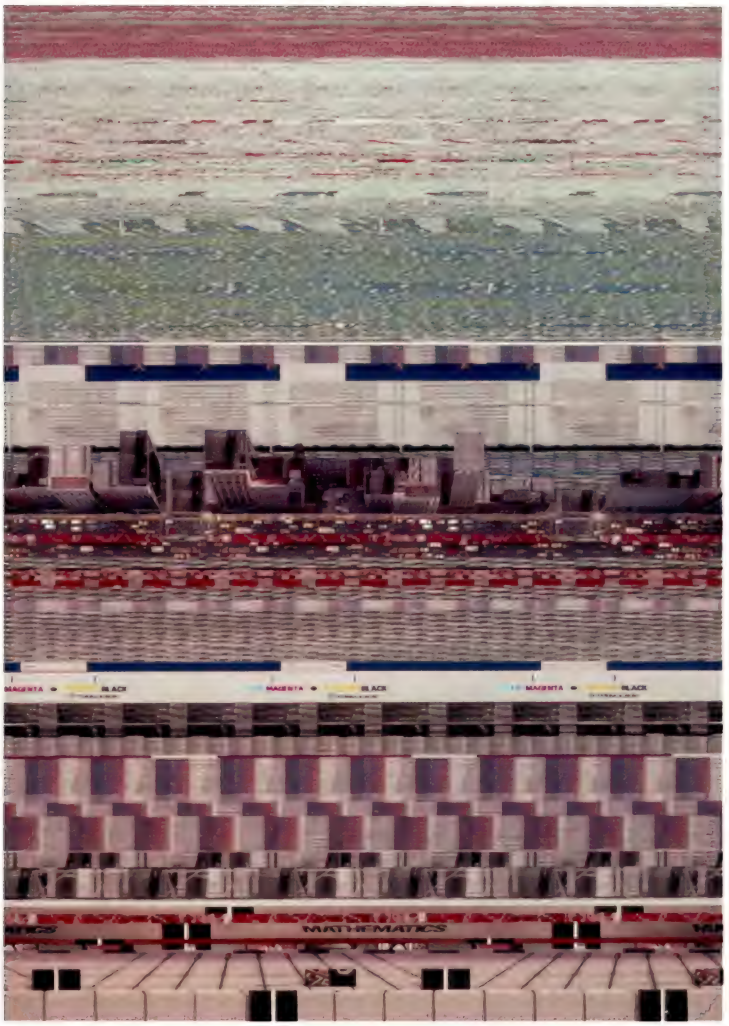
Duane D. Bray
Untitled | 1993

Dye sublimation print
10 x 8 inches



Bonnie Kane
New Life Forms | 1993

Cactus print
36 x 47 inches



Robert Bowen and Karen Sideman
Math II | 1994

Cactus electrostatic error
diffusion print
48 x 36 inches

Karen Sideman and Robert Bowen
Polymath | 1994

Cibachrome
40 x 30 inches

COLLABORATOR
Cibachrome imaging output
by The Color Wheel

Philip Casamayor
Untitled #3 | 1993

Iris print
17 x 11 inches

Anna Z. Ursyn
End of the Street | 1993

Cibachrome
30 x 15 inches

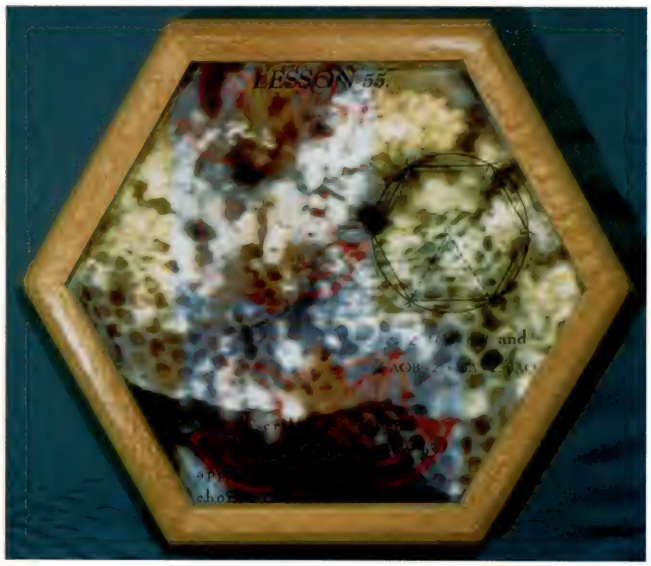
David Glynn
Apex | 1994

Shaped canvas, acrylic
computer painting
32 x 46 x 28 inches

Nancy Macko
BP Army I (The Waggle Dance), 5 BP Band 4: Eclipse, Beesight Hex (Lesson 55) | 1993

Cibachrome output, silkscreened plexiglass, custom lacewood frame
13 x 15.5 x 2 inches
13 x 34 x 2 inches
13 x 15.5 x 2 inches

detail, right
overview, below



Jean-Pierre Hébert
N'a pas dit son premier mot | 1993

Hewlett Packard plotter, India ink
on paper
35.5 x 25.5 inches

Kathleen Chmelewski
Lightning | 1993

Laserprints, collage
12 x 12 inches

Barbara Nessim
Veiled Egg | 1993

Laser print xeroxed on rag paper,
hand painted with acrylic
44 x 34 inches

Robert Bowen
Untitled | 1994

Anamorphic sculpture,
laminated Cactus electrostatic
error diffusion print
8 x 36 x 36 inches

COLLABORATOR
Guy Kudo constructed the chromed anamorphic cylinder

Pamela Hobbs
Love and Technology | 1993

Iris print
44 x 32 inches

Corinne Whitaker
Urban Man | 1993

Inkjet Print
27 x 27 inches

Anil Melnick
The Pen is Mightier | 1993

Iris inkjet print
32 x 24 inches

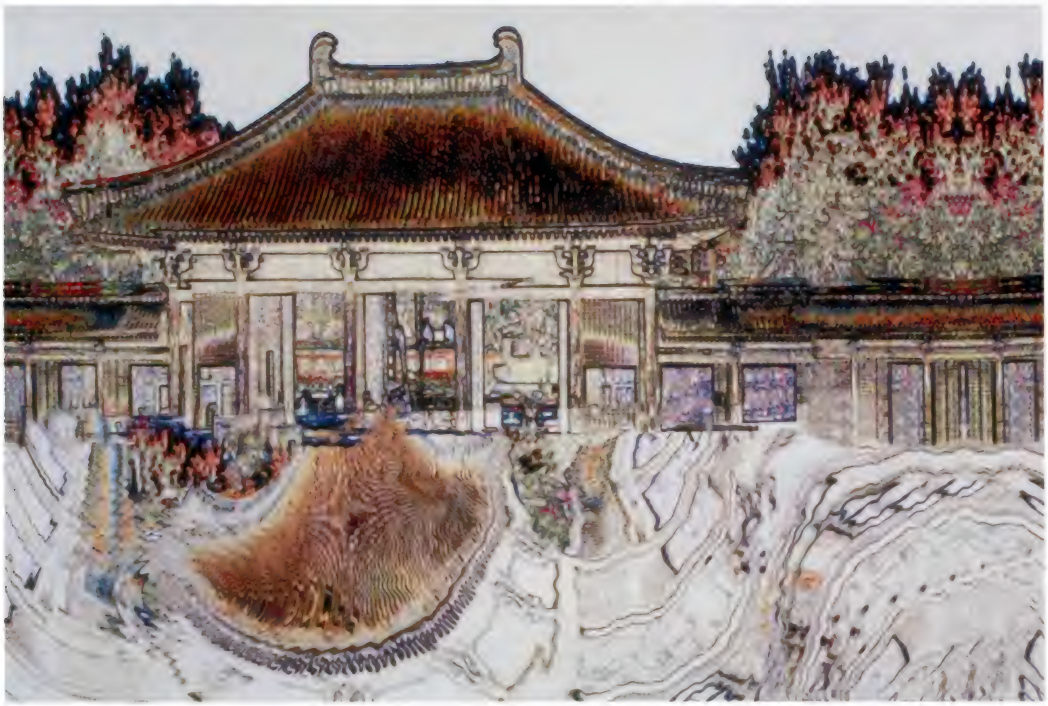
COLLABORATORS
Iris prints made at Peter X+(C), New York
Source image by Marville

Annette Weintraub
Sgraffito | 1994

Tiled and laminated Phaser print
31 x 47 inches

Madge Gleeson
First Things First | 1992

Mixed media
22 x 22 inches



Hui-Chu Ying
Xian Series | 1994

3M Rainbow print
19 x 25 inches

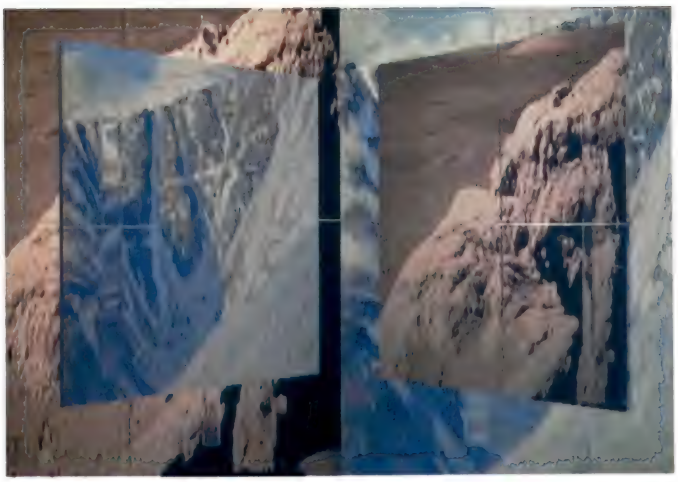
Christopher Burnett
Tomorrowland: Anamorphic Landscape Studies (Text cut-up)

Laserprint
14 x 11 inches

picturesque The woman looked pretty, except >
picturesque appearance Having procured a blac>
picturesque pomp of his dress and accoutremen>
picturesque figures,all crossing themselves, >
picturesque

Christopher Burnett
Tomorrowland: Anamorphic Landscape Studies (Moonscapes)

Color print
14 x 11 inches



Alexander Jamison
Equinoctial Sleep | 1993

Iris SmartJet print
7.5 x 10.5 inches

Deanne Sokolin
The Covering Series #2,
Enrobed Head | 1993

Digital photograph captured
with leaf digital camera back,
Kodak XL7700 electronic
thermal dye sublimation print
7 x 7 inches

Deanne Sokolin
The Covering Series #3 | 1993

Digital photograph captured
with leaf digital camera back,
Kodak XL7700 electronic
thermal dye sublimation print
11 x 11 inches

Deanne Sokolin
The Covering Series #1 | 1993

Digital photograph captured
with leaf digital camera back,
Kodak XL7700 electronic
thermal dye sublimation print
11 x 11 inches

Kathy T. Hettinga
Valley Petroglyphs II | 1992

Tektronics thermal wax print
16.75 x 12 inches

Liz Crimzon
Mann | 1993

Cibachrome print
24 x 30 inches

Louise Krasniewicz
Postquake LA:
Still Life #1 | 1994

Dye sublimation print
9 x 12 inches

Louise Krasniewicz
Postquake LA:
Still Life #2 | 1993

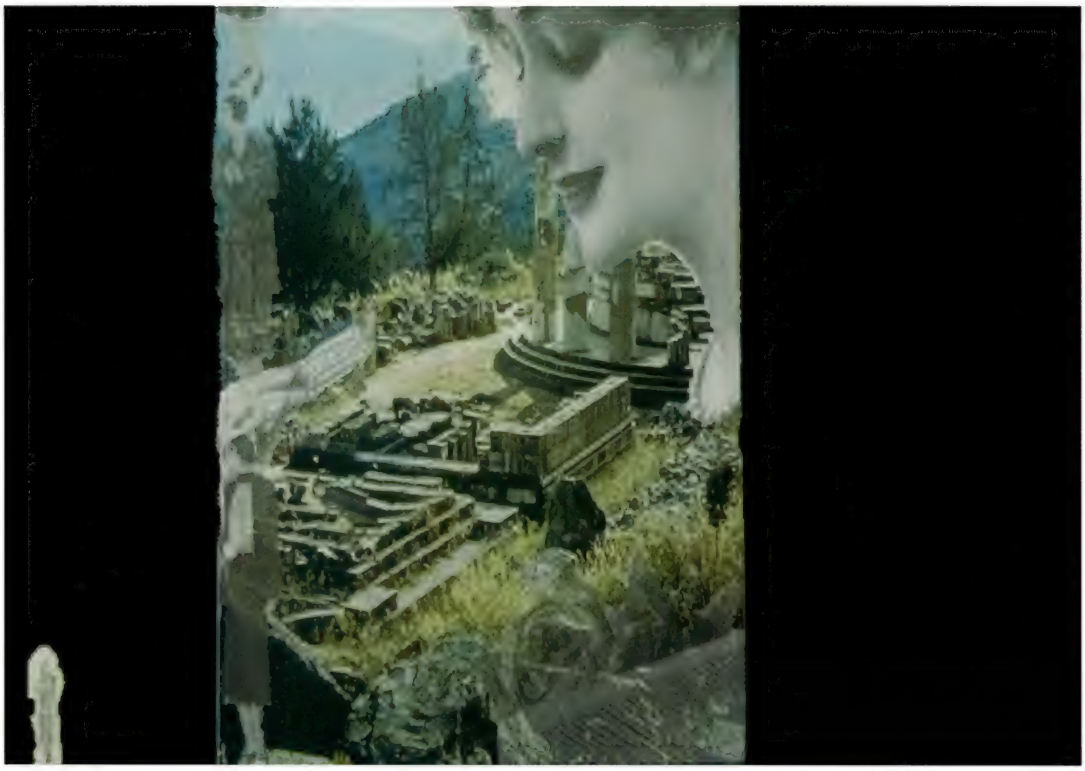
Dye sublimation print
9 x 12 inches

Valéry Grancher
Dysfonction | 1994

Cibachrome collage
.65 x .5 meters

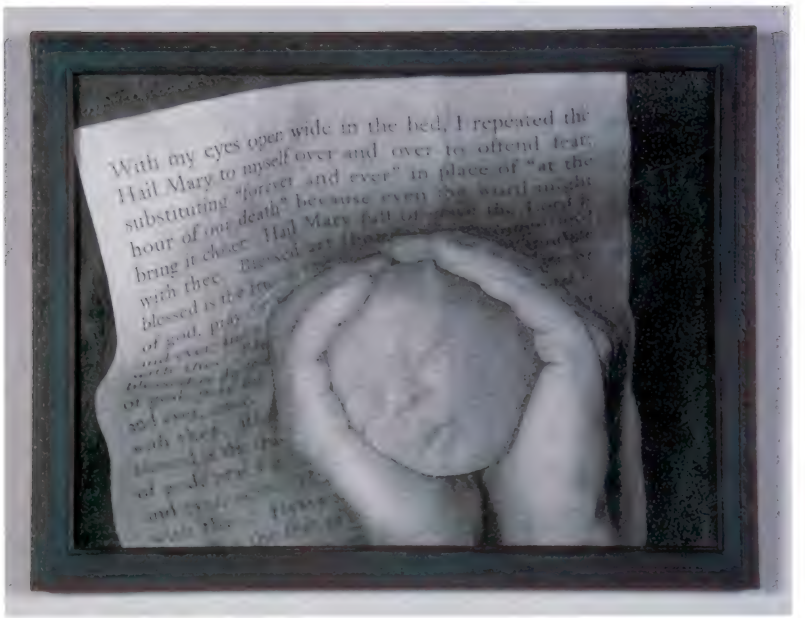
Dorothy Simpson Krause
Blue Madonna | 1993

Iris 3047 print enhanced
with gold leaf
30 x 22 inches



Sheri Wills
A Brief History (detail) | 1994

Color print
4 x 36 inches
(5 images printed as one panel)


With my eyes open wide in the bed, I repeated the
Hail Mary to myself over and over to offend fear,
substituting "forever and ever" in place of "at the
hour of our death" because even the word might
bring it closer. Hail Mary

Kathleen Chmelewski
Hail Mary | 1992

Laserprints, collage
9 x 12 inches

Anil Melnick
Evans vs. Weston | 1992

Iris inkjet print
24 x 24 inches

COLLABORATORS
Iris prints made
at Peter X+(C), New York
Source images by Evans and Weston

Raffals Estate
(Anthony Raffals, Emilia Rafalowski,
Richard Raffals, Judith Raffals)
Memorium Triptych (detail) | *1993*

Inkjet print
7.5 x 9.6 inches
(each panel of triptych)

Daphne Longo
Boy Crazy | 1993

Print
44 x 24 inches

Carmen Roman
Search of Identity | 1994

Prints
8 x 10 inches (each panel, triptych)

Victoria Vesna
Rambona | 1993

Dye sublimation prints
6 ft 9 inches x 5 ft 10 inches

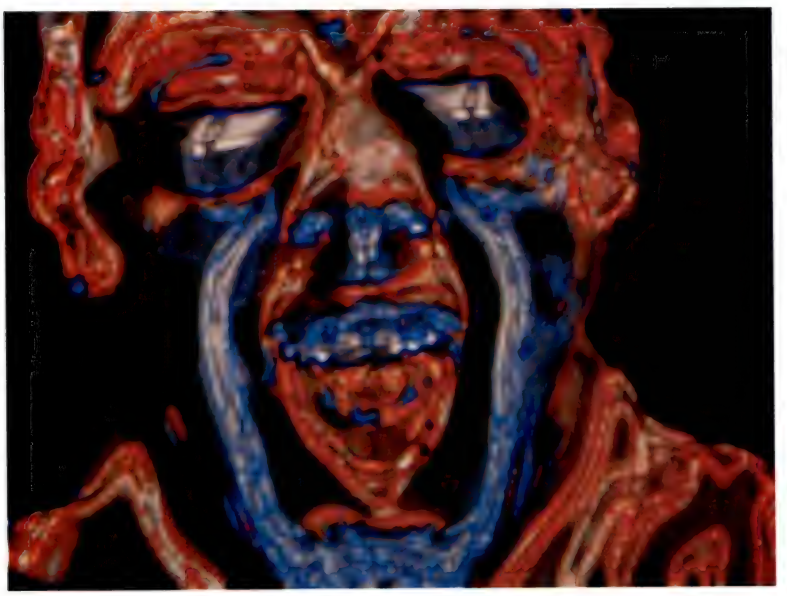
overview, *right*
detail, *below*

Peter Voci
Photomask #2 | 1993

Print
20 x 30 inches

Peter Voci
Photomask #4 | 1993

Print
20 x 30 inches



Dino Bagdadi
Self Portrait | 1993

Iris print
10.5 x 8 inches

Judith Artoux
Flame | 1993

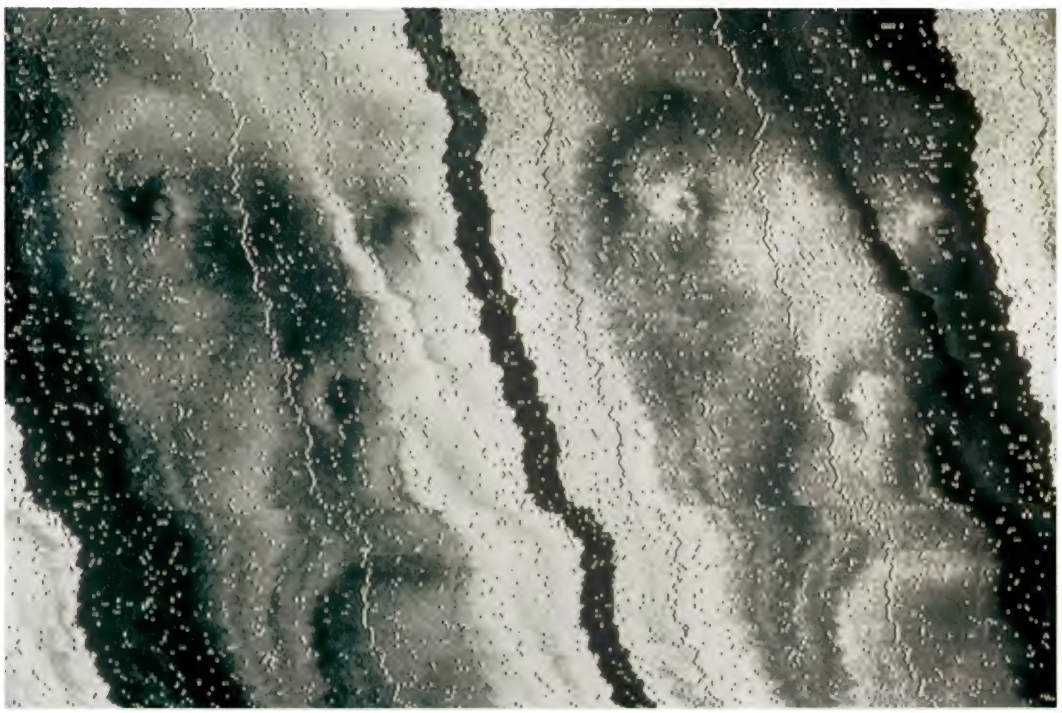
Inkjet
12.75 x 10 inches

Romanna J. Flores
Stories Over
Dessert—Part One | 1993

Photograph
27 x 20 inches

Dorothy Simpson Krause
Anatomy Lesson | 1993

Iris print enhanced with gold leaf
and watch parts
22 x 30 inches



Heather Fernon
Surface Tension | 1994

Cibachrome
20 x 30 inches

Bill Woodard
Safe Sex: Reconfigurations of Desire | 1993

Cibachrome
16 x 20 inches

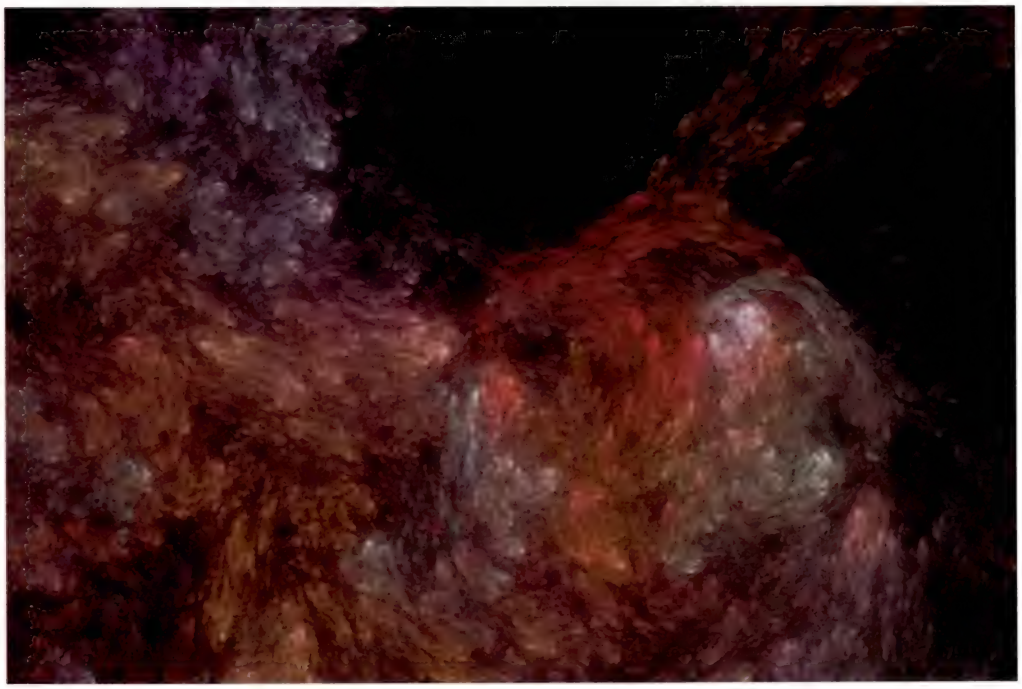
Christopher Landreth and (Art)^n
Virtual Bust/Franz K. | 1994

PHSCologram
30 x 30 x 5.25 inches

COLLABORATORS
Stephan Meyers, Craig Ahmer,
Janine Fron, Ellen Sandor

John Kahrs
Radiosity Ellipses with Depth of Field | 1993

Iris print
15 x 24 inches

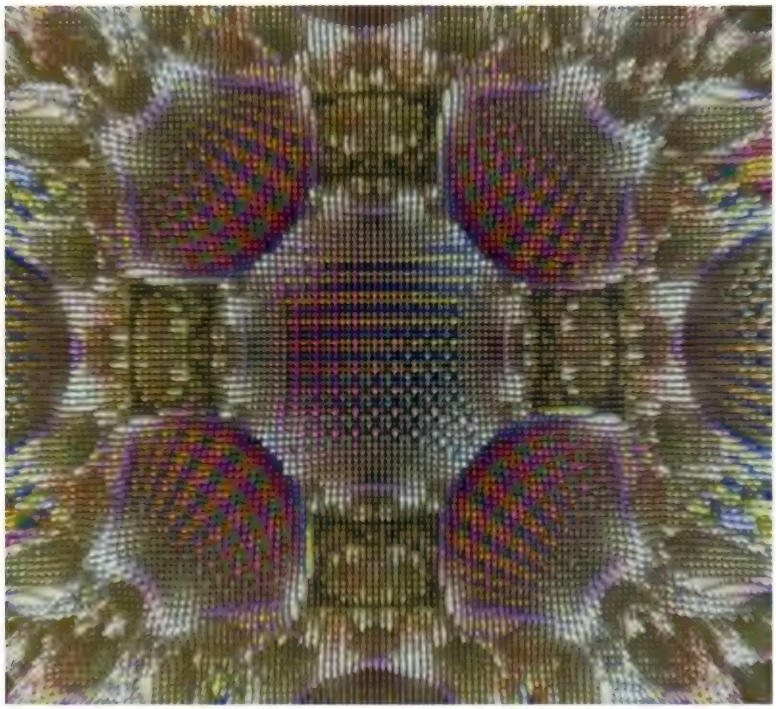


Scott Draves
Flame #12 | 1993

Print
8.5 x 11 inches

Robert Herrick Russ
Azure | 1993

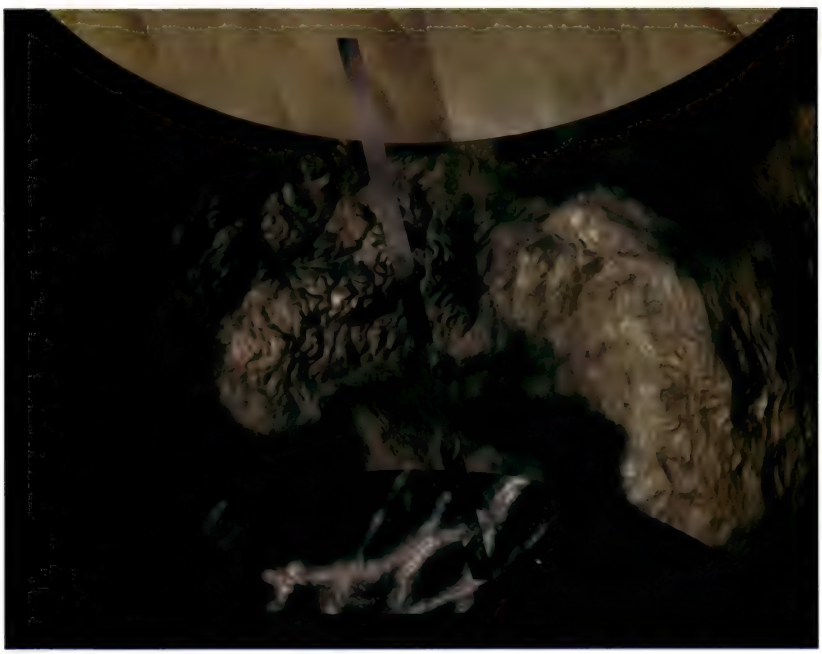
Print
19 x 24 inches



Hiroko Inakage
MM9505 | 1994

Photographic enlargement
81 x 81 centimeters

COLLABORATOR
Masa Inakage

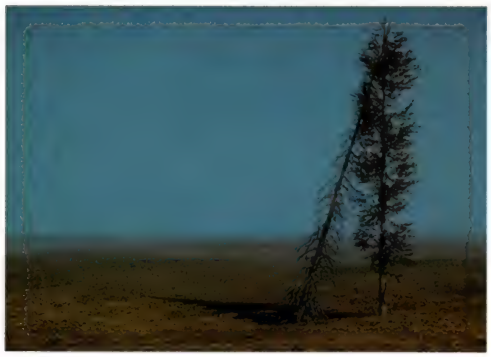


Kevin Geiger
Smoke and Mirrors I | 1994

Cibachrome
16 x 20 inches

Kent Rollins
Imi & Vita | 1993

Cibachrome
8 x 5 inches



Midori Kitagawa-DeLeon
Seasons of Life | 1994

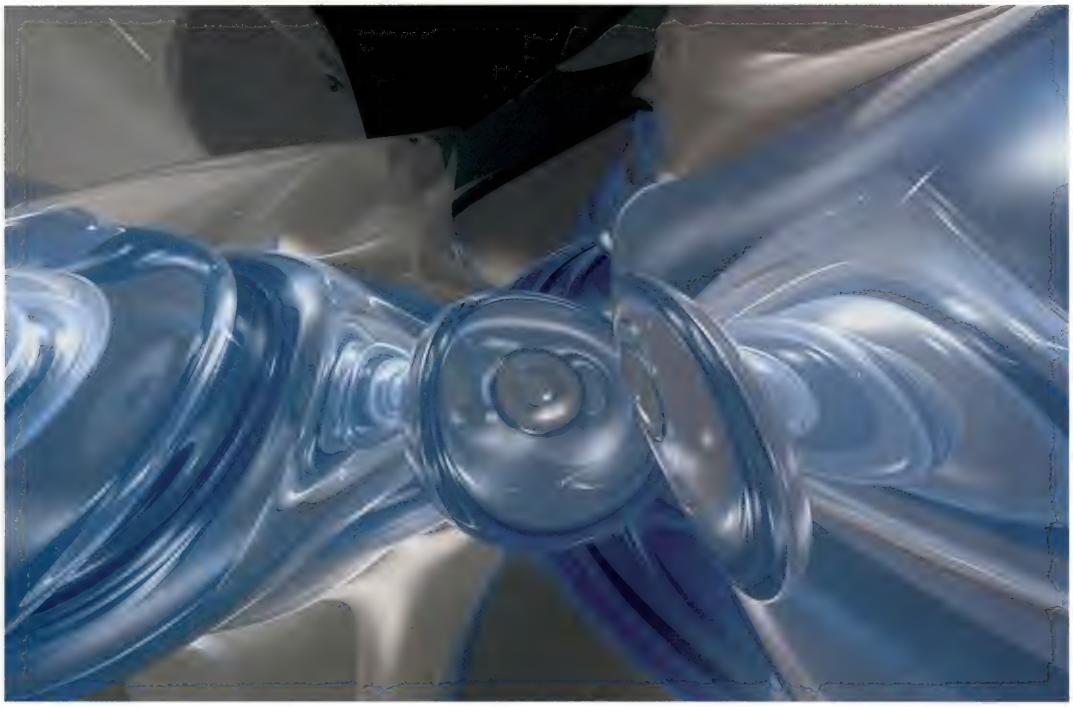
Cibachrome prints
7.5 x 10 inches (each, 4 elements)

COLLABORATOR
Tom Benoist (Interactive Effects, Inc.)

Stewart McSherry
blue worms

Iris inkjet
34 x 47 inches

COLLABORATOR
Rendering courtesy of Silicon Graphics Corporate Center



Kevin Suffern
Blue Glass | 1993

Photographic print
40 x 60 centimeters

ANIMATION

Shigeru Tamura
Ursa Minor Blue (excerpt)
4:00 minutes

HARDWARE/SOFTWARE
Quadra 700 and 900, NAC Hypergraphy, Macromedia Director, Studio 8, Superpaint

COLLABORATORS
Tomiyo Hiruta, Mitsuo Shionaga, and Kaoru Matsuzaki, producers

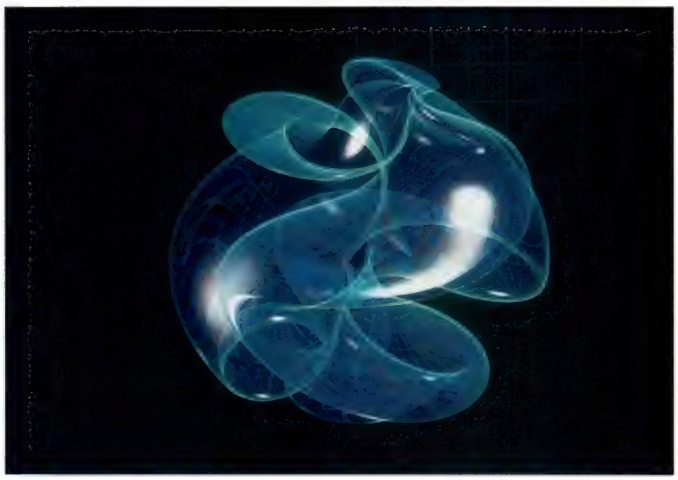
Apple Computer (Japan) and NAC Corporation, contributors

Sony Corporation, Sony Music Entertainment (Japan) Inc., and Ai Ga Areba Daijobu Co. Ltd., production support

Yuji Furata
Plastic Operation
1:45 minutes

HARDWARE/SOFTWARE
Sony News 3870, 5000; original software

COLLABORATOR
Taiyo Kikaku Corp. production support



Yina Chang
Fantasy of Spring
2:30 minutes

HARDWARE/SOFTWARE
Sun/Sparc, SGI Indigo, Macintosh, Abekas, 3D Space Digitizer, in-house software written at ACCAD

COLLABORATORS
The Advanced Computing Center for the Arts and Design of Ohio State University, and Mills/James Production, production support

Brad Coop, editing

Victor Alexeeff and Mark Snider, music

John Donkin and Steve Spencer, animation software

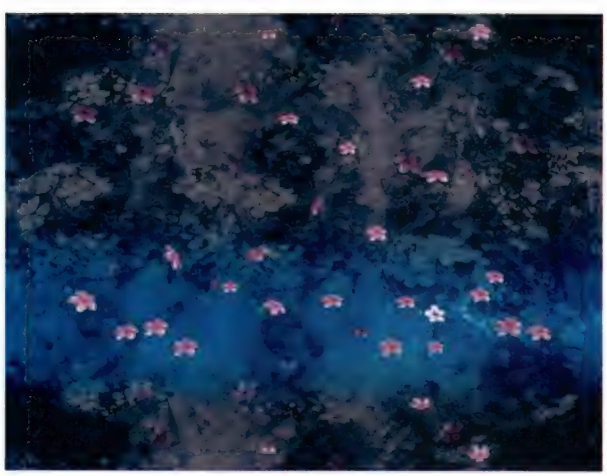
John Donkin, modeling software

Scott Dyer, rendering software

Jeff Light and Pete Carswell, image processing software

Steve May, particle system software

Beth Holfer, deformation software

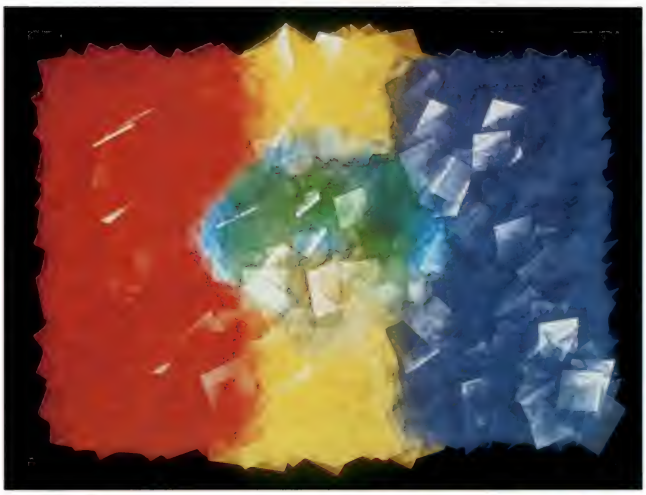


Kazuma Morino
Color <—> Control: Flags
1:25 minutes

HARDWARE/SOFTWARE
Sony News 3870, 5000; original software

COLLABORATORS
Yoshiyuki Usui, music

Satoshi Tsukamoto, Hidemoto Nokada, and Kenichi Kobayashi, programmers



Yasuo Ohba
Furble
1:35 minutes

HARDWARE/SOFTWARE
Silicon Graphics Indigo 2 Extreme, original software

COLLABORATORS
Namco, music

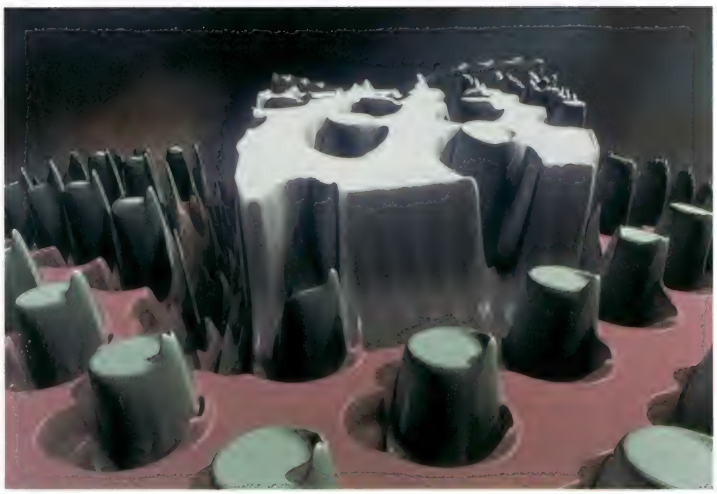
Rolf Herken
Displaced Dice
1:30 minutes

HARDWARE/SOFTWARE
HP 735 CRXZ (for interactive work), FDDI-connected cluster of eight HP 735 workstations (for parallel rendering), Wavefront, SOFTIMAGE

COLLABORATORS
Thomas Zanker, creative and technical director

Achim Gieseler, music

Alexander Lobodzinski, system and software support



William Latham
Biogenesis
5 minutes

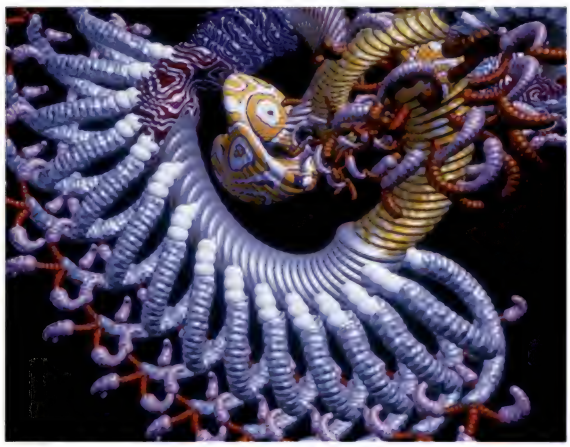
HARDWARE/SOFTWARE
IBM RISC/6000, IBM Power PC, Winsom, ESME

COLLABORATORS
Stephen Todd, software

Susie Bissel, animation software

Michel Redolfi, music

Channel Four Television and the Arts Council of Great Britain, funding



Adem Jaffers and Jeff Jaffers
Rave Safe
2:30 minutes

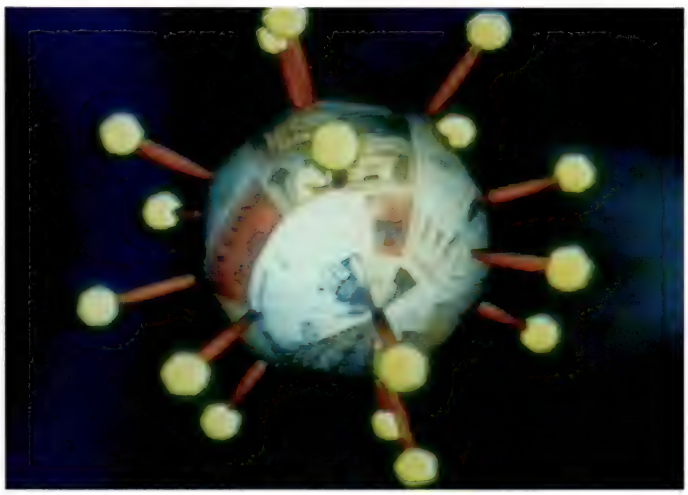
HARDWARE/SOFTWARE
Amiga, Opalpaint, Dpaint, Morphplus, Imagine, Digiview

COLLABORATORS
Emerald Films, production support

Tracy Walsh, producer

Third Eye, music

Department of Health, NSW; AIDS Council, NSW; and NUAA, funding



Oliver Lannaud
Les Muriens
3:10 minutes

HARDWARE/SOFTWARE
PC 486, Venice Studio Getris

COLLABORATOR
Pierre Henon and Morgane Furio

Atelier d'image et d'informatique ENSAD, production support

Troy Innocent and Elena Popa
Techno Digesto Fetishism
1:29 minutes

HARDWARE/SOFTWARE
Apple Macintosh Quadra 950, Macromedia Director, Cosa After Effects, Adobe Photoshop, Paint Alchemy

Brian Steiner and Timothy Keon
Mistaken Identity
1:20 minutes

HARDWARE/SOFTWARE
Silicon Graphics Indigo XS24, Abekas A66, Wavefront

COLLABORATOR
Ringling School of Art and Design, production support

David Hendricks, music

John Walker
still life
1:10 minutes

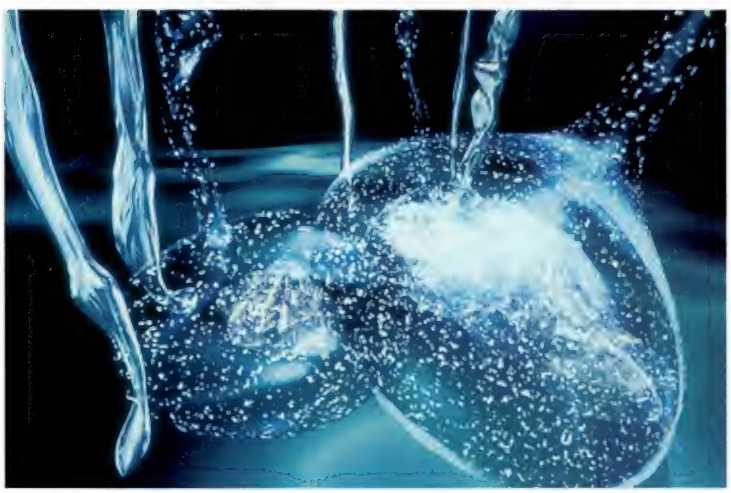
HARDWARE/SOFTWARE
SGI, Wavefront, Eddie, Unreal Renderer

COLLABORATOR
Texas A&M University Visualization Laboratory, production support

Jules Bister
Oscillation
3:00 minutes

HARDWARE/SOFTWARE
Silicon Graphics 4D35 and Indigo, SOFTIMAGE 4D Creative Environment

COLLABORATOR
Atelier Bister Animation Art, production support



Xavier Casadesús
Broken Childhood

HARDWARE/SOFTWARE
SGI, Explore TDI, Wavefront

COLLABORATOR
Universitat de les Illes Balears, production support

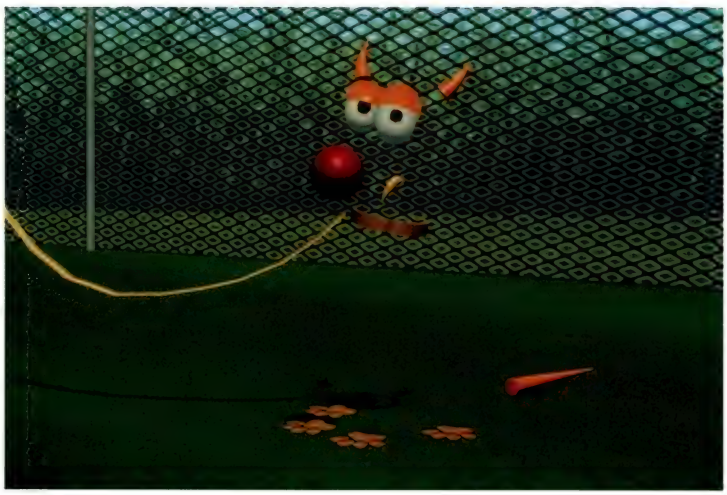
Jeff Pratt
Uncle Louie's Obedience School
1:22 minutes

HARDWARE/SOFTWARE
Silicon Graphics Indigo XS24, Abekas A66, Macintosh IIci, SOFTIMAGE, Adobe Photoshop

COLLABORATOR
Ringling School of Art and Design, production support

Brian Matthews, music

Ed Cheetham, voice talent



Suriyachat Singhakowin
Camoflage
2:30 minutes

HARDWARE/SOFTWARE
Entre 486, Crystal Topas

COLLABORATORS
Savannah College of Art and Design, production support

Valerie Hallier
Monster Party
3:07 minutes

HARDWARE/SOFTWARE
SGI Indigo, TDI Explore

COLLABORATOR
Curtis Watts, music

Jane White
Bolero
5:26 minutes

HARDWARE/SOFTWARE
SGI, Quantel Harry, Ascension Flock of Birds, SOFTIMAGE

COLLABORATORS
Pizazz Pictures Ltd., production company

Mario Cavalli, director

Sue Goffe, producer

Angela Cocker, production assistant

Ashley Potter, art director

Jane Turner, choreographer

Felipe Gonzalez and Gemma Barcenilia, performers with the orchestra of Berliner Philhamoniker conducted by Pierre Boulez

Natalie Zita, motion capture and 3D designer

Mike Milne and Simon Smith, 3D animators

Chris Mortimer and Tim Osborne, digital editors

Tim Webber, Henry

Fiona Walkinshaw, post-production producer

Not pictured:

Maurice Benayoun and Alain Escalle
Mirage Illimité
1:45 minutes

HARDWARE/SOFTWARE
Silicon Graphics, SOFTIMAGE

COLLABORATORS
Z. A Production, Grand Canal, and Mikros, production support

Jacob Keizer, additional animator

Eve Ramboz, additional Harry and Paint Box

Shine Fitzner
Window Verses
1:34 minutes

HARDWARE/SOFTWARE
Silicon Graphics Indigo, Abekas, Macintosh, Wavefront, Photoshop

COLLABORATORS
Ringling School of Art & Design, production support

Michael Graham Allen, music

Jordi Moragues
The Hit

HARDWARE/SOFTWARE
Silicon Graphics, Explore TDI, Wavefront

COLLABORATORS
Universitat de les Illes Balears, production support

Manuel K. Santos
Realidade Real
3:45 minutes

HARDWARE/SOFTWARE
TDI Explore, Photostyler, SGI, PC 486, Wavefront, 3D Studio, Corel Draw, Photopaint

COLLABORATORS
INESC, production support

Miguel Azeguime, music

José André, Fernando Margarido, and Pedro Castanheira, additional modeling and animation

Kim Bauer, Michael DiComo, Daniel Leung, and Jaquelyn Martino
Don't Drop the Package | 1993

COLLABORATOR
Pratt Institute, production support

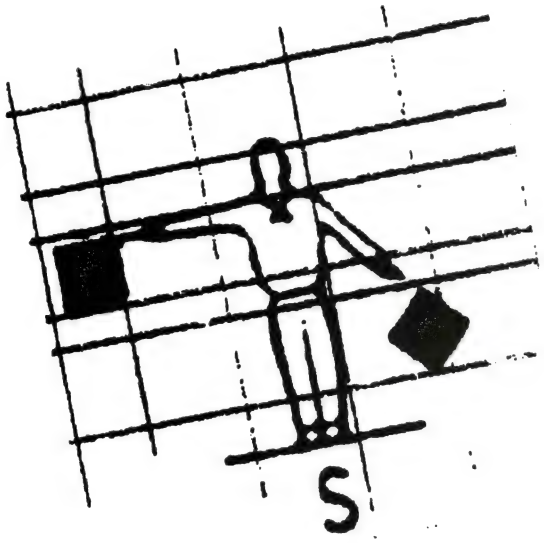
Drawing on icons from pop culture, this interactive work is inspired by cultist obsessions with religion in our present-day world. At strategic points in this round-the-globe adventure, the viewer must make choices between actions that may be perceived as good or evil. The true path results in divine salvation, while the false path leads to sure damnation.

Gertfried Stocker and Horst Hörtner
Winke Winke

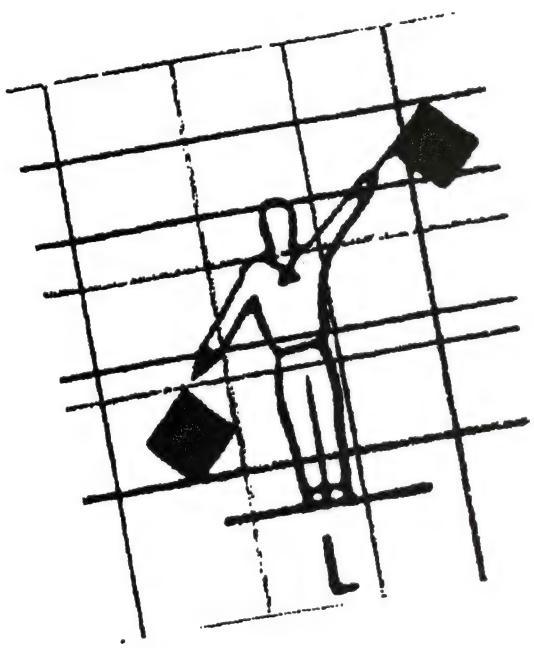
COLLABORATORS
Arnold Fuchs, Toni Mareshofer, Wolfgang Reinisch, and Jutte Schmiederer

The highly suggestive force of marine imagery meets the immateriality of digital information, which is not yet surrounded by myths.

During the French Revolution, the first optical telegraphy network was established (under government control) in France from 1794 onwards. The system's achromatic objectives, which were already available at that time, were capable of spanning long distances. The invention of the electric telegraph was vehemently opposed by these supporters of visual telegraphy. Ever since, their line of reasoning has determined the discussion on open media and communication.



In Winke Winke, a simple computer terminal (modem, keyboard, and monitor) located in a public space is connected to a robot set up over the roofs of the city. Visible over a long distance, this robot visualizes the messages entered into the computer by means of the international marine semaphore system. Each letter typed into the keyboard or received via the modem is immediately translated into the corresponding semaphore sign.



From the roof of a high building in a neighboring town, a video camera with a powerful telephoto lens records the robot. These pictures are fed into a computer that recognizes the signals by means of motion scanning (digital picture acquisition) and outputs them on-screen – again as letters.

This project leads back to the cradle of current communication technologies that are about to radically change the world's appearance. The basic kinetic structure of the digital communication process is slowed down by the "effort" of translating, of understanding.

Tim Binkley
Rest Rooms

COLLABORATORS
Heather Wagner
Eva Sutton
Dan Preda
Todd Brous

One of the enduring mysteries of life is the other washroom. Public lavatories remain a bastion of segregation as well as a haven of modesty. They have recently become a battleground for gender equality over the issue of annoyingly one-sided queues. A charged nexus of privacy and parity, rest rooms provide a suitable sanctuary from which to contemplate social issues facing a telecomputed world. Will cyberspace infiltrate this bifurcated domain?

Computers and telecommunications are converging in an alliance that challenges some of the most fundamental parameters of social interaction. Rest Rooms is an interactive installation designed to provoke thought about changes in our understanding of privacy and gender, and to provide a forum in which social and political questions can be raised: What will privacy be like in cyberspace? Will limits still be drawn to establish a personal space, and if so, where will the boundaries fall?

The installation consists of two computers installed in a rest room outfitted with video cameras and connected in a network. The screen of each computer is divided into four regions. One region displays a small video image from the camera located at that site. A larger area displays an image from the video camera in the other rest room. This enables people in each rest room to see and talk with people in the other rest room.

A third region is a common "graffiti" space, in which people in both locations can write or draw simultaneously on their common "bulletin board". The fourth region continuously runs Quicktime movies of snippets from gender-related television advertising. This installation offers a forum in which participants can discuss existing and future spatial, political, and social demarcations that separate the sexes.

Tom Leeser
Indiscriminate Visions

COLLABORATOR
Bill Topazio

"Indiscriminate" is used to describe something that is chaotic and random in nature. "Vision" is defined as the physical act of seeing. It also refers to a dream, trance, thought, or mystical appearance, or an idea, an object or the imagination. Indiscriminate Visions is a virtual environment that presents personal visions in a format designed to promote cross-cultural dream sharing.

Using video animation and editing, common dream elements are extracted from different dreamers: people with diverse cultural, economic, and religious backgrounds. The act of dreaming becomes transformed from a personal and private ritual to a shared experience, framed as a part of a greater collective subconscious.

The interactive video piece is installed as a virtual space that insulates the viewer from all exterior distractions. The room is similar in design to a photo booth or a church confessional. Inside, there are two video monitors: one nine-inch black and white monitor and one 12-inch color monitor, mounted side by side. The black and white monitor displays dreamers recounting their visions, while the color monitor plays back the video collages.

Unlike typical interactive programs that include viewer choices and branching capability, this system is random. The video has been transferred to a video disc controlled by a computer that randomizes the playback of the video each time a new viewer activates a sensing switch by entering the space. By exposing viewers to random collections of images and text, Indiscriminate Visions reintroduces people to their dreams and gives them a connection between an external media- and information-based material world and the internal visionary subconscious.

Marta Guitart
Please, Touch Me ... | 1993

The computer is more than an object. It can also be seen as an icon and a metaphor suggesting new ways of thinking about ourselves and our environment. Computers raise questions about what it means to be human.

Cybernetic systems consist of an entire array of machines and apparatuses that exhibit computational power. Such systems contain a quotient of (albeit limited) intelligence. They are all "cybernetic" in the sense that they are self-regulating systems within predefined limits.

The interactive installation "Please Touch Me ..." consists of seven Macintosh computers installed in a dark room. Each machine stands on a wooden cuboid, playing a computer-generated animation of a heart shape. These hearts move rhythmically, shrinking and expanding according to a human breathing sound, which is different in each computer.

The viewer establishes some kind of relationship (interacts) with the machines by approaching them individually and touching their "touch screens." The computers respond to being touched by changing the rhythm and intensity of the breathing. These qualities represent the idea that computers have a condition associated to them, so they can express passion, anger, and all sorts of different human feelings. The response changes depending on who is interacting with the computer, and when the interaction occurs. With its own "personality," each machine responds differently from the others.

The following installations have also been accepted by The Edge (for descriptive text, see the following pages).

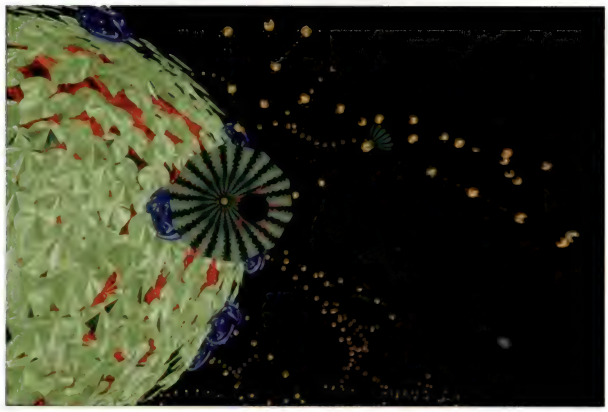
John McCormack
Turbulence (top) (page 182)

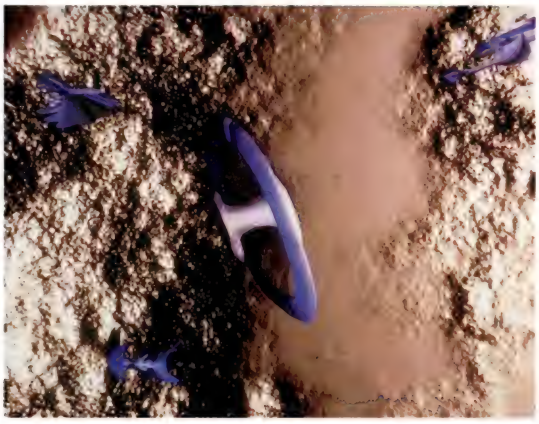
Christa Sommerer
Laurent Mignonneau
A-Volve (middle) (page 172)

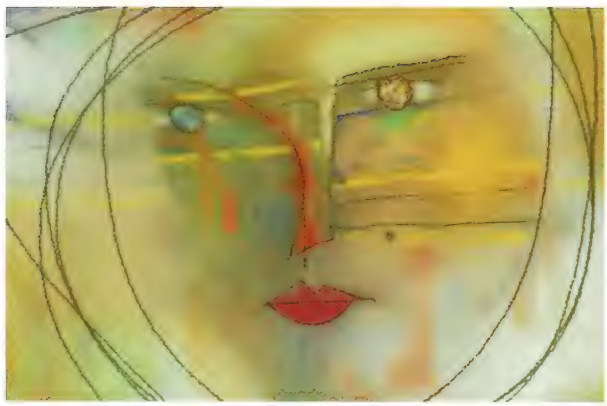
Toshihiro Anzai
RENGA (bottom) (page 184)

COLLABORATORS
Rieko Nakamura
Machiko Kusahara

David Blair
Wax Web (not pictured here) (page 181)







ESSAY ABSTRACTS

The full text of these Art and Design Show essays can be found on the SIGGRAPH 94 Multimedia CD-ROM. Some of these essays are presented as multimedia documents.

There are No Philosophic Problems Raised by Virtual Reality

by James Elkins

There is widespread agreement that virtual reality presents serious new challenges to perceived ways of thinking about such fundamental concepts as reality, simulation, representation, perception, and sensation. It has been seen as a practice that might have deep consequences for conventional ways of construing the mind-body problem, including the minimal requirements for a body, requirements for the coherent reception of sensation, and the relation between reason and intuition. Most fundamental of all, it has been said to entail a new kind of space, differing from Cartesian and other spaces and requiring new definitions of space and form. This paper argues, on the contrary, that virtual reality does not raise any new philosophic problems.

Computer Sculpture: New Horizons

by David J. Keskeys

An essay that focuses on opportunities for a new approach to computer-generated sculpture through the use of the interactive, user participatory attributes associated with virtual reality technology. The text briefly reviews the progress of sculpture from a static, physical art form through the use of computers as sculpture visualization tools, towards true 'virtual sculpture' as a metaphysical, three-dimensional experience. The author discusses two of his own recent prototype virtual reality pieces to demonstrate his projection of possible future trends in the viewers' immersion in sculpture as an activity and an art form, not merely as an observer of a set of objects.

The Engineering of Vision and the Aesthetics of Computer Art

by Lev Manovich

The rise of modern image industries, such as computer graphics, human factors research, or computer vision, can be seen as a part of the shift to the post-industrial society of perceptual labor. In contemporary society, human vision has become the key instrument of labor: the channel of communication between human and machine. If the industry aims to make human vision as productive and as efficient as possible, the computer artist, in contrast, can be defined as a designer of bad interfaces: interfaces that are inefficient, wasteful, confusing.

Aesthetics and Practice of Designing Interactive Computer Events

by Stephen Wilson

Much confusion and hyperbole surrounds discussions of the aesthetics of interactive computer events. This essay works to clarify some of this confusion by analyzing the differences between interactive and non-interactive events, reviewing the variety of forms included under the umbrella term "interactivity," and investigating the theoretical rationales offered to support claims of interactivity's superiority derived from psychological, political, art historical, and techno-historical sources. Building on this analysis, the essay suggests extensions to current GUI design canons that uniquely attend to interactivity as an aesthetic issue. It also investigates the challenging interactivity possibilities of emerging technologies.

Guidelines for Faculty in Computer-Based Media in Fine Art and Design

Document presented to the College Art Association and the SIGGRAPH Education Committee by concerned members working in computer-based media as a result of typical circumstances that faculty working within this area routinely encounter and that need to be addressed in guidelines that are specific to the medium.

This document briefly outlines the kinds of administrative and financial support necessary to sustain programs using computer technology and provides information about faculty working in this area that could be used in making accurate and comprehensive evaluations in hiring, promotion, and tenure. The College Art Association and the SIGGRAPH Education Committee have been asked to endorse this document.

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Macromedia

Isaac Victor Kerlow
Pratt Institute

Barbara London
Museum of Modern Art

Joan Truckenbrod
School of the Art Institute of Chicago

Introduction

Researchers and educators have nourished the insatiable need for exploration and have submitted a powerful variety of experiences for SIGGRAPH 94's SIGkids event. The event creates a mini-conference for kids featuring personal technologies, multimedia, scientific visualization, and virtual reality. As they became mentors for kids, experts have built trust, networks, and true friendships.

SIGkids focuses on exploration of the Internet and multimedia while creating links between industry and the classroom, just as education is exploring these new possibilities.

SIGkids answers the technological and educational challenge in the following ways:

• Through the on-going work of SIGkids, industry is challenged to develop meaningful partnerships with schools. We have found that the process is as important as the product in establishing new partnerships. Future products will be more creative as a result of the young people's contributions.

• Educators are experiencing new freedom and meaning as they team with industry to provide a technology-oriented environment in which students can create. SIGkids demonstrates creative ways to utilize this interactive medium.

• Educators are also becoming facilitators instead of teachers and experiencing the creative power that results when they let the students lead. SIGkids is all about kids working with professionals who become their mentors, kids teaching kids, and teachers as facilitators.

• Hardware and software designers who are assisting with donations for SIGkids are seeing education as a new marketplace with high expectations and open-ended needs. Their involvement in SIGkids allows them to tap into the creativity and excitement of this growing market.

There is no need for age restriction on SIGkids activities. With these new technologies, an eight-year-old may be at the same level as an 18-year-old or even an adult. One of the great phenomena of computer graphics is that intense interest and desire to learn are the basic requirements for success. Couple that with the right equipment, software and a willing and able mentor, and magic happens for everyone involved.

That magic is exemplified by the 30 contributors who were selected to participate from the 60 who submitted entries to SIGGRAPH 94's SIGkids. We have 12,000 square feet in Hall E of the Orange County Convention Center. Our neighbor, the Edge is the adult counterpart to the interactive magic the kids are creating. It's a powerful mix.

This year's SIGkids event was developed in four phases:

1. Researchers and educators developed projects and presentations that would interest kids. Many of these experts became mentors to interested young people.

2. Educators refined their computer-graphics skills through a series of four-week workshops offered in cooperation with SIGkids and Florida Art Education Association at the University of Florida, Gainesville.

Rie Takaba, *age 18*
Homewood-Flossmoor
High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

3. The big event! SIGkids, a mini-conference within SIGGRAPH 94.

• An art show featuring art works from students all over the world. Canon is enhancing the show by enlarging some of the student art work to 22 inches by 33 inches.

• The First Annual International SIGkids K-12 Computer Graphics Animation Festival was assembled by Scott Lang of the United Nations International School. It is being shown in the Hall E Theatre next to SIGkids.

• Thirty projects, involving 188 spirited and dedicated SIGkids, researchers and educators feature innovative applications of the industry's best software and hardware. This creates an environment for over 1,000 children of SIGGRAPH 94 attendees to experience the interactive treasures offered by new technology.

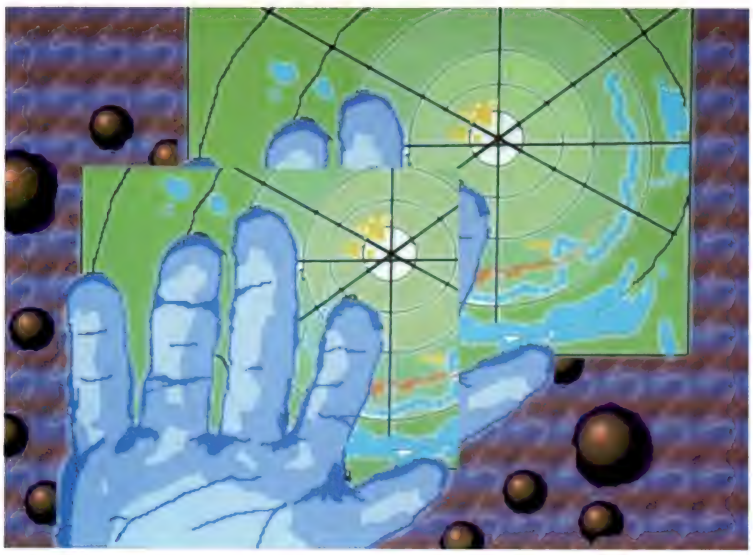
• Two SIGkids areas: courses and Cyber Park. The courses section features 12 courses taught by mentors and SIGkids for this year's new SIGkids. Cyber Park features 16 experiences for exploration.

• Walkways for observers, for easy access to the entire SIGkids area. Educators, researchers, writers, and all SIGGRAPH 94 attendees are invited in for a closer look.

4. The educators who are serving as SIGkids facilitators are working with the SIGGRAPH Education Committee and the Florida Art Education Association to produce a post-conference document that will be distributed to educators, parents, SIGkids, and researchers. The document will detail ways to create these powerful learning environments in the classroom or at home.

SIGkids offers an opportunity for all of us to enjoy the creations of kids who are highly motivated by visual productions. SIGkids 94 is the ideal forum for generating the information we need to create a vision for the future.

Nancy K. Ingle
Chair



Michael Vlasek, *age 17*
Homewood-Flossmoor
High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

SIGkids International Animation Festival

For years, the Electronic Theater has been one of the highlights of the annual SIGGRAPH Conference, and now the time has arrived for the animators of tomorrow to have their own forum. The SIGkids International Animation Festival features some of the world's best animations created by students in elementary and secondary schools.

Elementary and secondary education has traditionally been slow to fund and adopt new technology. This fact and the often prohibitive cost of computer graphics workstations prevent many schools from producing still images, let alone animations. But in recent years, the increasing power of desktop hardware and software, and accompanying price reductions, have helped make computer graphics a reality for many schools. Students are now finding that they have the tools to produce visuals equal to those they see in movies or on television. The SIGkids International Animation Festival is the showcase for their work.

The festival is an opportunity for those who are not familiar with the state of computer graphics in elementary and secondary schools to experience the works students are producing today. Viewers should also note the motivation behind the animations. Some were produced as partnerships between schools and outside partners, others were class projects, and many were inspired solely by interest in computer graphics.

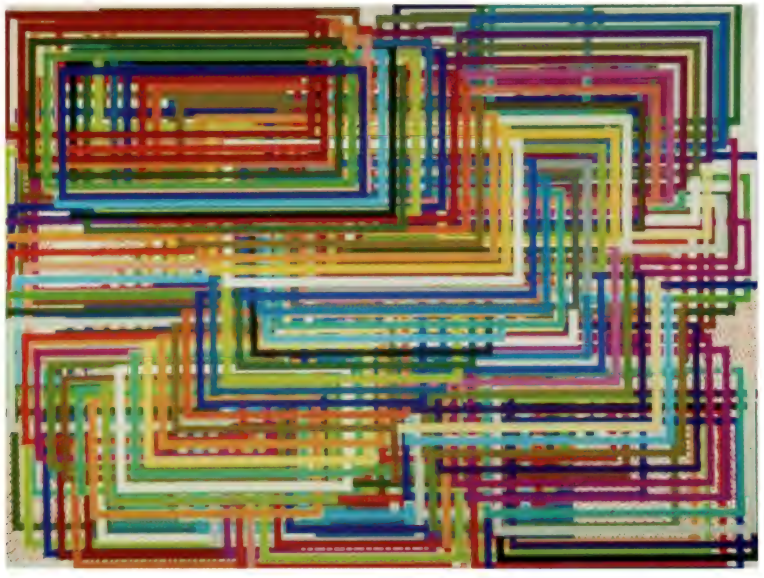
The animations presented in the festival have been produced with equal parts of hard work and imagination. They are shining examples of the possibilities when students gain access to the tools of the trade.

Scott Lang
United Nations, New York

Takashi Okamoto, *age 12*
Computer Graphic Arts Society
Tokyo, Japan

TEACHER
Ayumi Miyal

HARDWARE/SOFTWARE
Canon AXI/V
NTT Data, Art Tool Suisal



The Assembly Room

What's really inside that tan-colored box under the table anyway? Have you always thought that it was filled with mysterious, electrically charged demons doing all that binary math with the aid of some black art? Or pure rocket science that only Albert Einstein himself could understand? Well, that's absolutely not true.

At SIGGRAPH 94, SIGkids participants get first-hand experience in the construction of MS-DOS compatible computers from the board level up. The function of each individual component is explained prior to its integration into the machine's total framework. Individual SIGkids learn the intricacy and functionality of disk controllers, I/O boards, video display adapters, and the numerous other arcane devices that make up modern desktop computers. After the screwdrivers are laid to rest, SIGkids' efforts are rewarded as completed machines are booted, loaded, and enjoyed.

Reed Gaede
Time Warner Cable Full Service Network

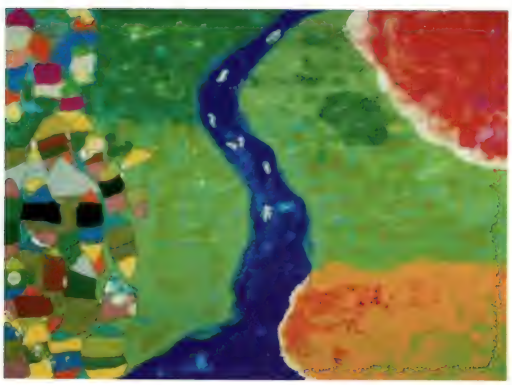
Scott Cook
David Levinson
Danny O'Leary
United Engineers/Martin Marietta

Swami
Sun Atlantic Computers

Michiko Haruta, *age 13*
Computer Graphic Arts Society
Tokyo, Japan

TEACHER
Ayumi Miyal

HARDWARE/SOFTWARE
NEC, 9801 FX
NTT Data, Art Tool Suisal



Sachiko Nakaguchi, *age 13*
Computer Graphic Arts Society
Tokyo, Japan

TEACHER
Ayumi Miyal

HARDWARE/SOFTWARE
IBM, PS/557 10S
NTT Data, Art Tool Suisal

Zimgraphics Teaches Children Multimedia

Participants have fun venturing through various software packages, learning a variety of topics, and being entertained by interactive storybooks and games. Mentors also teach participants how to create their very own multimedia storybooks. These children work at different stations, learning the fundamental skills required to create a computerized storybook.

The creative story-making process begins as the children structure their stories by selecting and personalizing the text for each page. Children use their imaginations to create characters and images for their storybooks. Throughout the day, they are called up to a "recording station," where they use a microphone to record their stories into the computer.

After the children have finished their work at the different stations, graphics are imported, text is added, and their storybooks begin to take shape. Each day ends with a sense of accomplishment and satisfication, as the participants admire their completed storybooks. The stories become keepsakes that are treasured by both parents and children.

Pia Zimperi
Zimgraphics

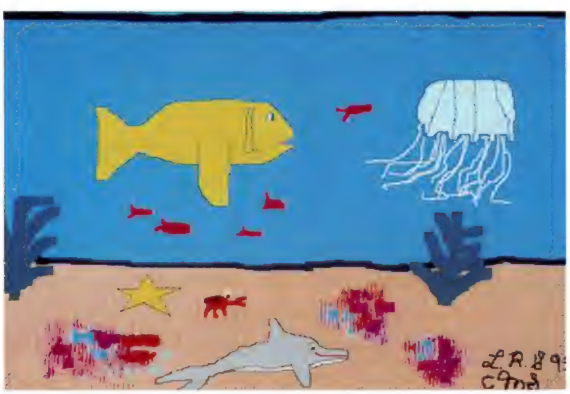
(ocean)

Carolyn Stana, *age 13*
Conway Middle School

Lauren Stana, *age 9*
Deerwood Elementary
Orlando, FL USA

PARENT
Jim Stana

HARDWARE/SOFTWARE
IBM 386 20 MHz clone
Microsoft Windows 3.1, Paint



(Fire)

Lauren Stana, *age 9*
Deerwood Elementary
Orlando, FL USA

PARENT
Jim Stana

HARDWARE/SOFTWARE
IBM 386 20 MHz clone
Microsoft Windows 3.1, Paint

Producing an Online Brochure For Tele-Distribution

In response to requests for information about a marine laboratory, participants in this session produce an online information source from a hardcopy brochure. The project uses online media to teach and capture the imagination of future information creators, translators, and consumers.

In collaboration with the MOTE Marine Laboratory, students develop an online brochure suitable for transmission over various types of networks. The laboratory supplies the raw information, and participants use various hardware and software tools to apply their creativity and imagination to achievement of a well-defined goal.

Raw information is captured in a desktop database that consists of both graphics and text. Participants access the database to create customized, electronic responses to simulated requests for information. Initial drafts are reviewed by the MOTE Marine Lab staff and sent back to the students. This gives participants experience in computer graphics and in network data communications. SIGkids learn to use constraints of the media to create an advantage.

This session produces a single brochure that could be sent as a response to a request for general information.

Alan J. Happ
IBM

Kathleen Miller
Cardinal Newman High School

Ingrid McEllen
MOTE Marine Laboratory

Malissa Booczko, *age 17*
Homewood-Flossmoor High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

Interactive Language Training

This exhibit demonstrates one of the Language Technology Projects at the University of Central Florida's Institute for Simulation and Training. The goal of the project has been to develop, evaluate, and produce language courseware for personal computers equipped with voice interfaces. "Pedro and Friends" uses hypermedia software shells augmented by specially developed software for authoring the courseware.

An English speaker wanting to learn Spanish, for instance, listens to a native speaker pronounce words, phrases and sentences, which are displayed. The student speaks into the computer's microphone, and the sounds are digitized and played back. The student's pronunciation can then be compared with the native speaker's. This cycle can be repeated as often as necessary. At the end of each unit, the program provides an assessment exercise.

This research project was designed to look at the effectiveness of the digital listen-record-and-compare feature that is built into the computer and available to the user on a random-access basis. The computer makes this process quicker and more accessible to the student. The voice interface feature allows the student to do more than listen and repeat. Until computer voice recognition is practical and affordable for school use, the record-and-compare feature represents the best non-human phonetic tutoring technology available.

Catherine F. Meyer
J. Peter Kincaid
Institute for Simulation and Training, University of Central Florida

Sandra Rios, *age 17*
Henry W. Longfellow School
Rochester, NY USA

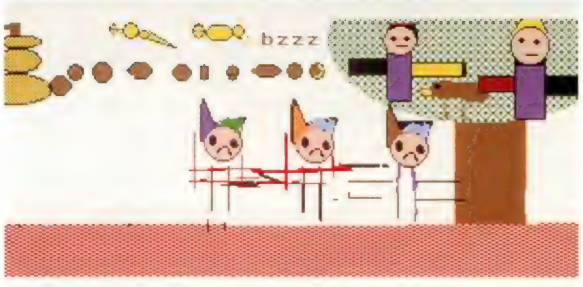
TEACHER
Stephen Jacobs
artist-in-residence, English as a Second Language Project

HARDWARE/SOFTWARE
Apple IIGS
Paint, Baudville

Jonathan Vega, *age 17*
Henry W. Longfellow School
Rochester, NY USA

TEACHER
Stephen Jacobs
artist-in-residence, English as a Second Language Project

HARDWARE/SOFTWARE
Apple IIGS
Paint, Baudville



English Discoveries

English Discoveries is a joint project with the Berlitz language teaching corporation. It features a computer-based multimedia English course, based on accepted curricula, that begins with the alphabet and extends through advanced levels. The course enables users to survive and thrive in an English-speaking environment.

Through real-life situations presented on screen, users can be involved in an animated (in both senses of the word) conversation with native English speakers. The course features digitized voice and music, high-resolution color graphics, and cel-animation with lip synchronization. It also includes an Icon-driven functional, friendly, welcoming interface.

The course is designed to provide a total learning environment. It accommodates many different learning styles and gives students exposure to all four language skills (reading, writing, speaking, and listening). Its adaptive system enables learners to progress at their own level and speed. One of its most fascinating features is its ability to refine pronunciation by recording and playing back the user's voice.

Lea Cohen
EduSoft

Julie Brocco, *age 18*
Homewood-Flossmoor
High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

Michelle Gochenour, *age 17*
Homewood-Flossmoor
High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

TeleCommunity Project

Through interdisciplinary telecommunications, the TeleCommunity Project fosters creative relationships and artistic expression, nurtures collaboration, and encourages cultural dialogue among young people throughout the world. In Cyber Park, a virtual studio experience, kids converse, conceptualize, and share art, ideas, and impressions using a broad range of technologies and techniques: email, computer/video conferencing, collaborative networked painting and 3D design, videophone and wireless communications, computer-to-computer fax, transfer of text and image files, screen-sharing, and interactive multimedia. Participants explore local and planetary concerns, seek imaginative solutions, experience cultural differences, form friendships, and invent metaphors that help them understand and engage the future.

The TeleCommunity Project has been hosted by the Pittsburgh Children's Museum, Duquesne University's School of Education, the STUDIO for Creative Inquiry, Carnegie Mellon University, and previous SIGkids events. TeleCommunity has organized and/or participated in youth cultural exchanges at Pittsburgh-area museums, institutions, and schools, and at many other locations around the world, including the Israel Museum-Ruth Youth Wing, Jerusalem; The Museum of Turkish and Islamic Art, Istanbul; the Fullerton Museum Center in California; the University of São Paulo; the Museum of Contemporary Art, São Paulo; OtherVisions Studio, Oakland; the CitySpace Project, with International Faculty of the NASA Challenger Space Center; and Duquesne University's Junior MultiCultural Computer Academy.

This project has fostered an evolving, international TeleCommunity that empowers children, parents, and teachers through extensive telecommunications processes.

Robert Dunn
Arc Vertuel, Inc.

Students participating in the TeleCommunity Project from Duquesne University's Junior MultiCultural Computer Academy.

Dunn

(left)
Portrait, from a digital video transmission during a TeleCommunity event

(right)
Collaborative networked painting Pittsburgh-Anaheim TeleCommunity Project

The Music Machine

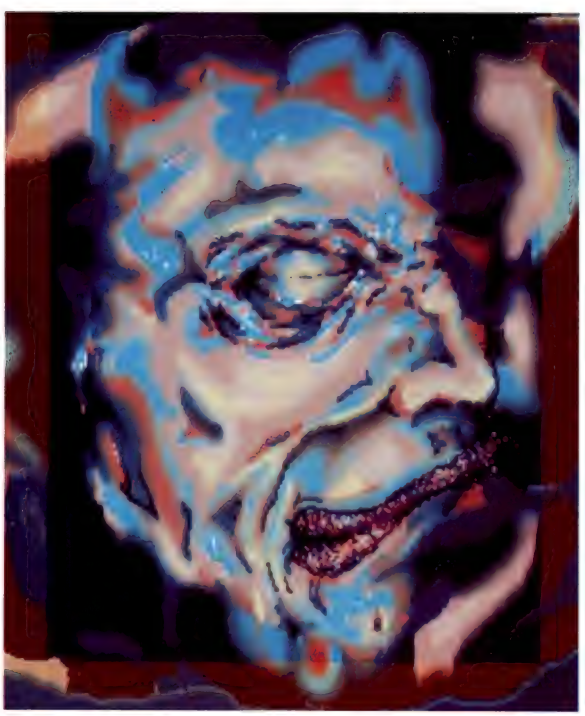
Sound, especially musical sound, is the most overlooked form of communication. The Music Machine, a challenging new software program, opens a fascinating window to aural experience. It provides a visual tool for kids to author original songs and interpret existing music with an interface that is friendly to both amateurs and professionals alike. With The Music Machine, players enjoy composing their own music as well as practicing and learning traditional musical elements, such as tempo and melody.

The Music Machine is versatile. It can be used by individuals, or several people working together on a network. When multiple players begin assembling a musical score, the software automatically queues multiple inputs to promote the highest possible degree of harmony and democracy.

The Music Machine is not a win/lose, "shoot 'em up" kind of game. Instead, it conjures up each player's unique creativity and encourages kids to participate in the creative experience. Competition is a daunting and debilitating motivating tactic, especially for younger children. This approach advocates cooperation and the power of positive reinforcement. Point accumulation display boxes and score cards are not part of the Music Machine environment.

Picasso once said: "Every child is an artist...the problem is how to remain an artist once he grows up." The Music Machine reactivates the artist inside us all. It offers tangible access to rhythmic dreams and cultivates them in a non-violent, supportive climate.

Erica Eusebio
Big Top Productions



Chris Flynn, *age 17*
Homewood-Flossmoor High School
Flossmoor, IL USA

TEACHER
Lorelei Jones

HARDWARE/SOFTWARE
Macintosh LCII
Color It

Hypertouch

The Hypertouch system produces audio and visual images based on bio-electric signals produced by participants. Through a series of electrodes, the Hypertouch interface measures the slight electric current that flows through human bodies when they are in physical contact. The interface converts the current to MIDI signals and sends them to a computer and a digital music sampler, where they are converted to visual images and sounds. The system functions as long as the current flows, no matter how many users are in the chain.

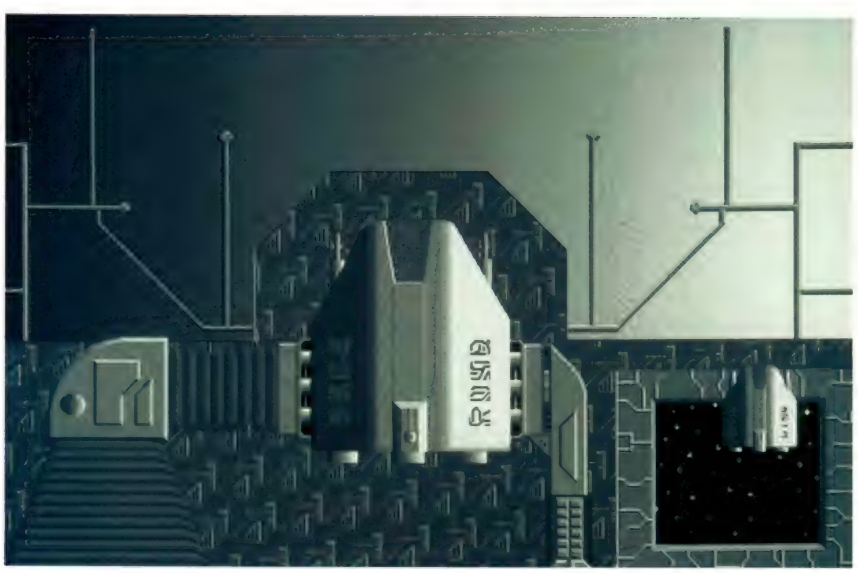
With the Hypertouch system, participants interact to produce images and sounds in a new live-performance environment.

Haruo Ishii
Trident School of Design

Matthew Raymond
age 17
Mainland High School
Daytona Beach, FL

TEACHER
Susan Preston

HARDWARE/SOFTWARE
Amiga 2500
Deluxe Paint IV



Visual Programming with MIDI

Participants in this workshop learn that "technophobia" of ones and zeros doesn't mean that one can't program. Provided with high-level, fun-to-use tools and the ability to control both visual and aural display devices from the computer itself, programming can be entertaining. In this enviroment, the definition of "multimedia" extends beyond the computer screen. Some of the topics explored in this venue are:

- How visual programming makes computers more useable.

- How visual programming techniques may be used to enhance an education professional's understanding of computer technology.

- Extension of the definition of "multimedia" beyond traditional limits.

Gohsuke Takama
Meta Sound Engineering

Klindt Whaley, *age 17*
Mainland High School
Daytona Beach, FL

TEACHER
Susan Preston

HARDWARE/SOFTWARE
Amiga 2500
Deluxe Paint IV, DigiView,
Art Department Professional

The Circus Project

In this enviroment, SIGkids participate in the creation of an ongoing animation project with a circus theme. They utilize a script, storyboard, and keyframes created by Mael and Eva Gerard, 14-year-old twins at the Centre Allende in Saint-Malo, France.

Over 40 children, ranging from 10 to 15 years of age, have already contributed images to the initial video, which will also be presented at SIGGRAPH 94 as part of an introduction to computer graphics created at the Centre Allende in October 1993 under the direction of Jean-Yves Gaultier.

SIGkids participants are invited to create new images, or to develop animations using existing key frames, which will be edited to create a new video. Participants use interactive software developed at IRCAM to create soundtracks. Participants also have the opportunity to create Quicktime movies from existing images and then add a soundtrack to the finished production.

Huguette Chenais
La Moisias

Arnauld Boulard
IRCAM, Centre Pompidou

Rodolphe Bailly
Conservatorie National des Arts et Meitiers

Jean-Yves Gaultier
Centre Allende

Achim Gliem
Cyclops Productions

Lydie Nguyen
Olivier Bonenfant
Xavier Le Dantec
SupInfoCom

Mael & Eva Gerard
Centre Allende

Oliver Zeller, *age 16*
United Nations International School
New York, NY

TEACHER
Scott Lang

HARDWARE/SOFTWARE
Amiga Toaster
Image Master RT
Canon Still Video

Nick Days

Nickelodeon believes that kids shouldn't have to wait until Halloween or their birthdays to celebrate a holiday. Every day should be a holiday! So Nickelodeon invented "Nick Days".

Now there's Eat Blue Food Day, Bubble Blowing Day, Finger Puppet Day, or Repeat Repeat Day Day. Children are treated to a holiday every single day of the year. Each new holiday concept is illustrated on Nickelodeon with a 30-second promo that includes 14 seconds of computer-created animation.

Several steps precede the animation process. All artwork, created by illustrators from around the country, is scanned and sent to "cleanup". The first stage of the cleaning process is done with Adobe Photoshop. Lines are thickened, stray pixels are eliminated, and images are resized for video format. Then the artwork is animated using Macromedia Director. After final cleaning, which assures that colors and motion are "broadcast-legal," the final animation is taken to "edit," where it is dropped into a 30-second promo.

At SIGkids, Nickelodeon animators walk kids through the full animating process. While the exhibit is primarily instructional, some kids will have an opportunity for hands-on experience. They will be able to scan artwork, help with "cleanup," or just stand back and watch.

This instructional exhibit demonstrates how streamlined computer animation has become. Most Nick Days spots can be fully animated in just one day.

Vicki Bowlin
Laurie Wahrenberger
Joel Krasnore
Craig Hibbard
Karen Giannone
Nickelodeon Studios

Erick Foster, *age 17*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/ SOFTWARE
Macintosh LC 520
Painter 1.2

Technology Training for the Future

What will the technology training of the future look like? The Edgewater High School SIGkids have a vision of their own that includes workstations, unconventional games, telecommunications, and an assortment of computer animations, including future product simulations.

The students have designed two of the workstations with a futuristic ergonomic style. The first is modeled after an artist's workspace, and the second has a more generic style. Each station houses a variety of software appropriate to the venue.

Another station is used for on-site development of three-dimensional interactive role-playing simulations. Photographic images of SIGkids visitors are added to the simulation as they pass through the venue. A third station houses a compilation of CD-ROM projects that students have been working on during the past school year. Participants are encouraged to explore any of the projects that interest them: Florida Birds of Prey, A History of Firefighting in Orange County, The Sport of Wakeboarding, and Technology Training Tips and Tools for Teachers. This station illustrates how interactive media can be developed by students to facilitate their own curricula.

The final station is a telecommunications link to the world incorporating an Internet connection and simulations that include video and sound. Also, student-produced animations and pictures of futuristic visionary products will be displayed on videotape.

Chris Carey, Paula Nowell, Andrew Brown, and students
Edgewater High School

Todd Steinemann, *age 17*
Edgewater High School
Orlando, FL USA

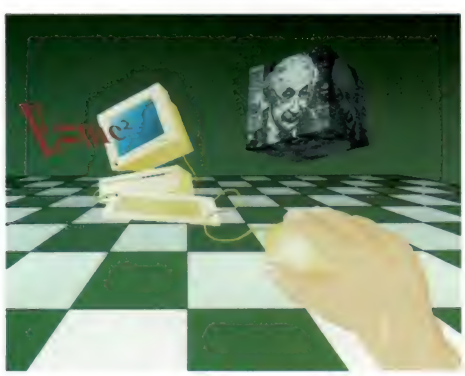
TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh LC 520
Video Paint

E. J. Shipley, *age 14*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh LC 520
Video Paint



3D Art, Animation, and Mixed Media

In recent years, the educational system has changed considerably. With the inclusion of computers in the classroom, kids of all ages have opportunities to learn and explore computer technology.

As vice chairman of the Tampa Bay ACM SIGGRAPH local group, I was approached by an instructor in the Pinellas County (Florida) school system and asked if we were interested in instructing the teaching staff in the use of computer graphics applications. We were thrilled to be given the opportunity to aid the school system, and we jumped at the chance.

Our involvement has given us exposure to the county's Magnet Schools and The Center For Advanced Technologies. The students who attend these schools are learning to master many of the same tools that professionals use every day.

As our interaction with the schools progressed, we were not surprised to see that students were occasionally having trouble with their computer systems – a very common problem for all of us. Members of the Tampa Bay SIGGRAPH group have helped the students overcome these challenges.

This SIGkids demonstration consists of the best works from a team of Pinellas County students: CD-ROMs, videos with music, animations, and QuickTime movies all merged into one creative presentation.

Mike Dooly
Tampa Bay ACM SIGGRAPH

Hans Mathre
Ken Worthendyke
Jon Cooper
Alex Winner
Mark Granning, *Instructor*
Julie Janssen, *Administrator*
Center for Advanced Technologies
Lakewood High School
St. Petersburg, FL

David Grigg, *age 16*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh LC 520
Video Paint

3D Rotoscope: Interactive Live Action 3D Animation

This workshop is a mixture of 3D animation techniques using rotoscoping. This time-honored special effects technique has been widely used since the late 1930s and early 1940s, when it was adopted by Max Fletcher, a pioneer cartoonist and special effects innovator.

With rotoscoping, a filmaker or videographer can seamlessly integrate elements of live action with 3D animation or cel animation. The technique has not only survived to the present day, but has been greatly improved over the decades and continues to fascinate moviegoers in films such as "The Abyss" and "Terminator 2."

For this workshop, students developed a story involving a high school girl who has befriended a lost alien creature. The creature depends on her to survive as she depends on his powers to save her from a school bully. The rotoscope consists of full-motion video capture and subsequent image mapping of the live video sequences onto a flat 3D polygon. All this leads to a fun-filled chain of events that integrates analog and digital information into a video that will be displayed at SIGkids.

In addition, a 2D and 3D interactive multimedia display will describe the technique in detail and provide a brief history of animation and the various traditional and not-so-traditional techniques used to achieve it. Some of the more unusual techniques were created by the students, who will be at SIGkids to explain and demonstrate 2D computer cel techniques as well as the 3D techniques used to create their video.

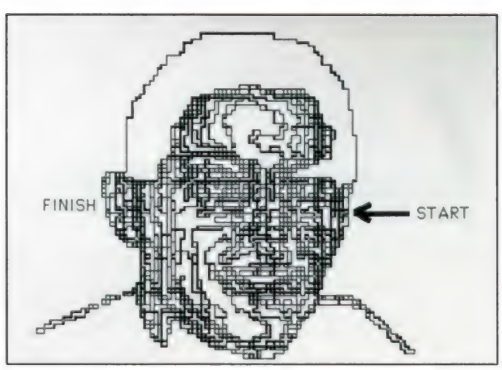
Kevin D. Gouvia
Lyman High School

Larry Mitchell
Metrolight Studios, Orlando

Jason Klein, *age 15*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh LC 520
Video Paint



Glenn Cerulli, *age 15*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh LC 520, Scanner
Ofoto, Video Paint

Technology & Communication: A Time Travel Experiment

Storytelling has always been, and is, a powerful means to express new thoughts, ideas, and dreams. Throughout time, individuals and groups have used storytelling to pass on common history, weave fantasies, or spread news. These tales have been passed on by word of mouth, through written accounts, and in poetry, song, and dance.

Today, stories are told in person, over the phone, via radio and television, in movies, or on computers. As personal computers become more available, they are becoming the tool of choice for expressing ideas. Whether you are writing a report or a letter, drawing a picture, or creating an animation, you probably have a story or event in mind which you wish to share. Some current software applications provide a collection of tools to enable better communication of these thoughts.

One such application, Kid's Studio from CyberPuppy Software, is designed to be an easy-to-use multimedia storytelling environment. In one program it brings together tools that enable the combination of illustration, writing, sound recording, and existing images across multiple pages. Pages can be viewed as slide shows or QuickTime movies with an assortment of transitions and effects, or they can be printed in gray-scale or full color for traditional, non-computer display.

This workshop uses Kid's Studio as a tool to conceptualize how people in earlier, pre-computer times may have accomplished the task of telling stories. Participants create tales of how an imaginary, not necessarily human, family solves the problem of telling their own tale at different points on a technological timeline.

Workshop members receive descriptions of the imaginary family's world as well as an important event that occurs in the family's life. These descriptions give details of what life was like for the family 1,000, 100, and one year ago. The challenge is to determine how family members can spread their news to relatives and friends given the technological environment of each time period.

Participants brainstorm solutions in one or more groups before breaking into teams to author a solution. The teams then present their results as multimedia stories. In many ways, the problem of deciding the best means of communicating the team's solution parallels the problem facing the imaginary family. Final stories are shared with the other groups and follow-up discussions focus on technology's role in communication and other aspects of life.

Christopher Haupt
CyberPuppy Software

Alycia Joy Shedd, *age 12*
Culdesac Elementary School
Culdesac, ID USA

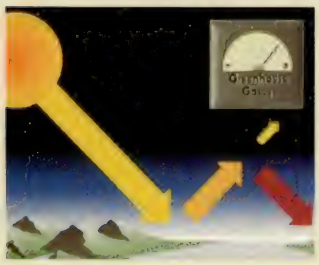
PARENT
Richard Shedd

HARDWARE/SOFTWARE
Macintosh Quadra
Kidpix

GeoMedia2

GeoMedia2 is the second in a series of educational hypermedia systems produced by the U.S. Geological Survey. The goal of these projects is to determine the effectiveness of hypermedia techniques in communicating complex earth science concepts to middle school students.

The theme of GeoMedia2 is global environmental change. It uses three modules to focus on the many physical, chemical, geological, and biological changes that have occurred throughout the Earth's 4.5-billion-year history:



- The carbon cycle, which illustrates the movement of carbon through the environment and how the cycle is affected by human interaction.

- The greenhouse effect, which explains the natural environmental process that traps heat in the lower part of the Earth's atmosphere, where it keeps our planet warm enough to sustain life.

- Time and change, which helps students learn about the geologic history of the Earth and the evolution of living organisms.

Each module contains four sections: animation, elements, glossary, and further reading. The GeoMedia2 prototype is being distributed to teachers on digital compact discs in exchange for evaluation comments.

Denise Wiltshire
U.S. Geological Survey

Carmelo F. Ferrigno & Kevin W. Laurent
U.S. Geological Survey

Eric Altson
InterNetwork, Inc.

SPONSOR & CO-PRODUCER
U.S. Geological Survey

GRAPHIC DESIGN AND CO-PRODUCTION
InterNetwork, Inc.

HARDWARE
Apple Macintosh Computers

AUTHORING SOFTWARE
Macromedia Director

Daniel Halsey, *age 16*
Florida State University School
Tallahassee, FL USA

TEACHER
Debi Barrett-Hayes

HARDWARE/SOFTWARE
Macintosh Quadra
Painter

Fractal Design Dabbler

Participants in this project gain hands-on experience with the newest image creation software from Fractal Design Corporation. Features include kids teaching kids in the use of Dabbler, Fractal's new "learn to paint and draw" program.

SIGkids have a unique opportunity to make an iron-on t-shirt transfer by manipulating and modifying stock images and a variety of natural-media tools into a work of t-shirt art. They can design a SIGkids logo and take it home as a souvenir.

Also featured: virtual drawing using Proxima's desktop projector and "magic wand" system. The "magic wand" allows the user interface to be projected on a screen and permits the user to "paint" without touching any hard surface. This system is a unique experience. It represents the most recent development in user interface technology.

Daryl Wise
Fractal Design Corporation

Amanda Davis, *age 15*
Florida State University School
Tallahassee, FL USA

TEACHER
Debi Barrett-Hayes

HARDWARE/SOFTWARE
Macintosh Quadra 700
Ofoto and Photoshop

Autodesk

The Autodesk Software Workshop is all about designing–about the imagination, skills, and technology it takes to turn ideas into reality.

Members of the Autodesk/SIGkids "PROJECT 94" team explore the outer limits of drawing, modeling, animation, and visualization with the same graphic design software tools that Autodesk supplies to architects, engineers, and other design professionals around the world. This is a hands-on project-in-progress; participants should be prepared to get involved in a learning experience in addition to having a good time.

Laura London
Autodesk,. Inc.

Will Fowler
San Jose Middle School

Nathan Walker, *age 17*
Florida State University School
Tallahassee, FL USA

TEACHER
Debi Barrett-Hayes

HARDWARE/SOFTWARE
Macintosh Quadra 700
Ofoto and Photoshop

3D Modeling

Tired of computer graphics that look flat and mathematically derived? This workshop illustrates the ease of 3D digitizing with contemporary technology. Using the industry's most popular software applications, participants probe objects on a table, watch them grow on the screen as their outlines are traced, and rapidly digitize the objects (or even the table itself).

A sculptor will guide SIGkids in using modeling clay to create original forms to be digitized.

Adult/student instruction teams lead by example and cover the following topics and more:

- The concept of a digitizing space and object mounting.
- The concept of a coordinate system and origin point.
- Model construction with the Metrecom digitizer.
- Looking for "holes" and filling in your model.
- Eye position and point of view.
- Light shading of the completed computer models.

The Metrecom digitizer used in this workshop is a six-axis, manually articulated digitizing arm. The system is mounted on a desktop surface and is manipulated by hand. Users can digitize key features of an object in single-point mode or aquire many points by dragging the probe over complex curves and surfaces. The system's controller calculates the location of the probe and communicates with the computer via a serial port.

In addition to the Metrecom, participants will be using standard Macintosh and PC computers with HyperSpace and AutoCad software packages.

Matt Kraus
Faro Technologies

Sherry Peters
Evans High School
Orlando, FL

(both photos)
Rob Knight, *age 17*
Florida State University School
Tallahassee, FL USA

TEACHER
Debi Barrett-Hayes

HARDWARE/SOFTWARE
Macintosh Quadra 700
Ofoto and Photoshop

Future Classroom

A research project, headed by developmentalist Nancy Navin of The Graduate Center, CUNY, and undertaken at the Ingersoll Media Center focuses on learning in the computer environment through expert-novice peer interaction in elementary school, middle school, high school, and post-secondary education.

The software employed in this environment promotes the operation of a feedback loop between the abstract computer environment and tactile, real-world applications:

• Original software on Egyptian mathematics brings children into the environment that generated a very physical conception of mathematics, culminating in the construction of the pyramids.

• Sim City 2000 allows kids to assemble a future city from the ground (and water) up. Building and maintaining a modern city involves consideration of a multitude of competing interests, as well as unpredictable random events. Success requires an ever-changing equilibrium of dynamic systems.

• Lego Dacta Control Lab offers a transparent interface pulling participants from the tactile, mechanical realm of building real-world working Lego models (conveyor belts, robots, vending machines, a plotter, etc.) into the operation of the finished models through computer programming. Visualization allows participants to follow the feedback loop process: programming modifications suggest new mechanical realizations and physical inventions require new programming.

• Macromind Director, MacroModeler and Swivel 3D, and related software provide a full-capability multimedia lab where, with minimal instruction, middle school and high school students quickly learn to master computer animation, sound, and graphics tools to create their own projects. As students acquire functional skills, they become aware of the software's flexible ability to support real-world content. Teachers learn to use these systems to develop teaching aids for their classrooms. Students move from serving their own needs to applying their multimedia authoring skills to projects that serve school and community needs.

At SIGGRAPH 94, this SIGkids learning environment operates with expert peer tutors, who are always available to assist participants. In addition, a Panasonic media wall displays works produced in this environment at the Ingersoll Media Center.

Nancy and Richard Navin
Image & Communications

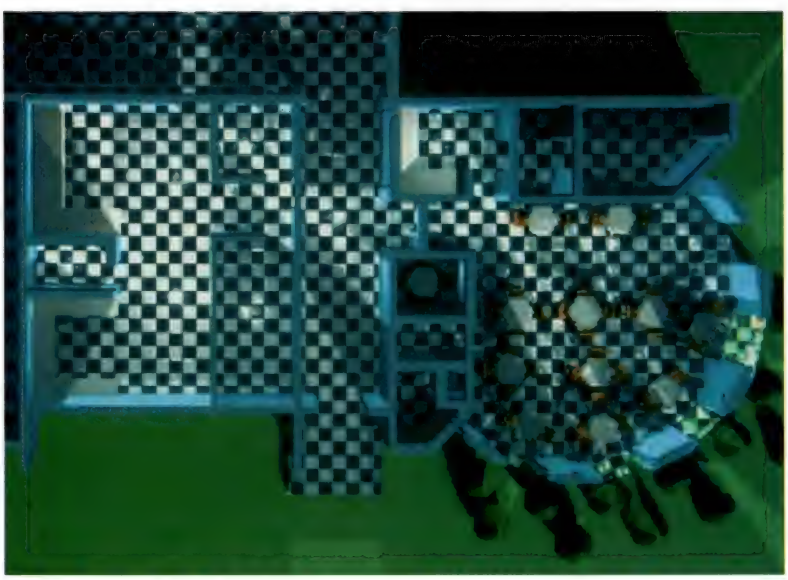
Nick, Chris, & Ricky Navin

David Bench, *age 18*
Evans High School
Orlando, FL

TEACHER
Nancy Ingle

MENTOR
Matt White

HARDWARE/SOFTWARE
Binary Arts
Strata Vision
Macintosh Quadra



Exploring Planet Earth with Graphics

Because they share a sense of wonder about Planet Earth and a desire to protect our natural environment, many researchers are using computer-created images to understand how air, water, and soil pollution can be reduced.

With large computers, it is possible to create moving animations that depict the flow of pollution at various sites. It is also possible, with computational modeling, to predict future polluting events. Using this approach, it is possible to examine how future clean-up efforts might affect contaminated sites.

Scientists and artists work as a team to create these animations. Sometimes, the results are seen by influential politicians, both in the U.S. and abroad, and the animations help to influence national laws and international agreements to protect Planet Earth.

Theresa Marie Rhyne
Martin Marietta, U.S. EPA

Nathan Willis, *age 16*
Mainland High School
Daytona Beach, FL

TEACHER
Susan Preston

HARDWARE/SOFTWARE
Amiga 4000
Video Toaster
Lightwave 3D

Modeling Natural Shapes With Fractal Geometry

This project allows students to explore how fractal geometry and finite automated methods can be used to generate computer models of natural shapes, such as snowflakes, ferns, and flowers. The project is divided into two parts:

1. A full-day course that covers some of the technical, behind-the-scenes details about fractal geometry and shows how these techniques can be used to write PC programs which draw various 2D fractal images.

2. An interactive exhibit based on existing software applications running on high-speed graphics workstations. The exhibit allows the user to create complex, natural 3D fractal shapes. It is designed for use by students participating in the course and others who wish to experiment with the production of natural 3D fractal shapes.

The course is intended for students with some prior programming experience who want to learn about fractal geometry techniques and use them in writing their own graphics programs. It covers both theory and practice through a series of hands-on exercises, beginning with the "chaos game." This exercise shows how a short PC program, using a simple set of rules, can generate a complex 2D fractal shape (the Sierpinski triangle).

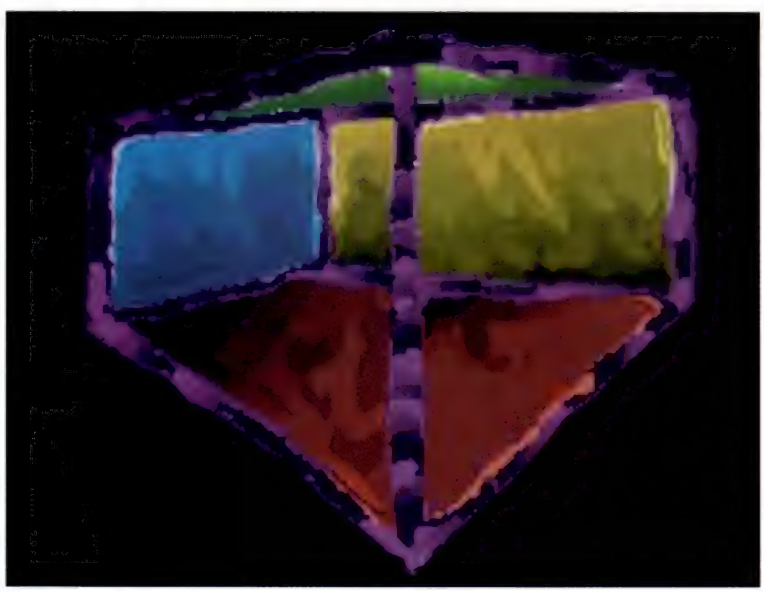
Following the exercises allows students to write PC programs using similar sets of rules (such as Iterated Function Systems and L-Systems) to draw more natural 2D shapes such as the vonKoch snowflake and the Black Spleenwort fern. In the final exercise, students learn how to use the interactive exhibit on the graphics workstations.

David Zareski
Cornell University

Mat Gonzales, *age 18*
Edgewater High School
Orlando, FL USA

TEACHER
Marsha Vandivort

HARDWARE/SOFTWARE
Macintosh IIsi
Easy Color Paint



DETOUR: From Storyboard to the CAVE

This presentation details the design procedure for an application developed for display on the CAVE VR system in SIGGRAPH 94's VROOM. The process began with a storyboard developed around the following premise:

A visual artist living in a seacoast town in Massachusetts sustains a head injury in a car accident, which results in damage to her brain, including the visual cortex. She is no longer able to pursue her art as before, and she wonders: "How can I express myself now? What is happening to me and my brain?" A year later, she begins to pursue a long-term interest in virtual reality.

The result was the VROOM project: "DETOUR: Brain Deconstruction Ahead." Participants in this exploration of DETOUR's development become acquainted with the process of transforming an idea into an artistic presentation. They also learn about the multiple presentation forms possible for a project such as DETOUR, which makes full use of the high-end immersive media potential of the CAVE, but could also be shown in different ways on a variety of "lesser" platforms.

This project has many implications for the future of immersive computer-based media. Possible uses include visualization, artistic expression, and therapeutic patient education systems.

Rita Addison
and David Zeltzer
Massachusetts Institute of Technology

Marc Mandeng, *age 17*
United Nations International School
New York, NY

TEACHER
Scott Lang

HARDWARE/SOFTWARE
Amiga Toaster
Image Master RT
Canon Still Video

Virtual Worlds

"If you have built castles in the air, your work need not be lost; that is where they should be. Now put the foundations under them."
–Henry David Thoreau

Virtual reality came to the Casper, Wyoming schools in the summer of 1993 when Eben Gay of ERG Engineering, Inc., and Rob Santiago of Virtual Dynamics presented a workshop to interested teachers. A year later, students from fourth grade to high school are experienced builders of virtual worlds.

The tools are simple: IBM 486-based PCs, LCD shutter glasses, PowerGloves, joysticks, and Cyberscopes. Many younger students also use Macintoshes to gain experience in non-immersive environments. PC software includes REND386, VREAM, and Universe Filebench. Virtus WalkThrough is used on the Macintosh.

At Kelly Walsh High School, virtual world creation offers challenging new opportunities to use programming skills and applied mathematics. On a typical day, you can find Lacosta designing a tour of the earth's layers beginning at the Grand Canyon. Or Karen will take you to Egyptian shores in a small boat and on into the dark recesses of the pyramids for an investigation of the sarcophagi hiding within.

At Crest Hill Elementary School, Brittney and her classmates explore the conditions that allow a ball to bounce. Her virtual ball bounces correctly after she analyzes factors such as weight, elasticity, and "touchability." Fourth graders at Fairdale Elementary School use Virtus WalkThrough on the Macintosh to design building renovations, then submit their plans, complete with design rationale, to the architects. Nick from Bar Nunn Elementary School and Tim from Mountain View Elementary School collaborate to create a complete 3D reproduction of Fort Caspar from Lieutenant Caspar Collins' original 1865 2D plans.

"Have you seen the future? We built a castle today."
–Casper Students

John Russell
Natrona County School District

Wandjina Brown
age 16
United Nations International School
New York, NY

TEACHER
Scott Lang

HARDWARE/SOFTWARE
Amiga Toaster
Image Master RT
Canon Still Video

SIGkids Committee

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CyberCreations, Inc.

ADMINISTRATIVE ASSISTANT
J. Marshall Pittman
Valencia Community College

Tammy White
Binary Arts

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Lawrence A. Finch
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Reed Gaede
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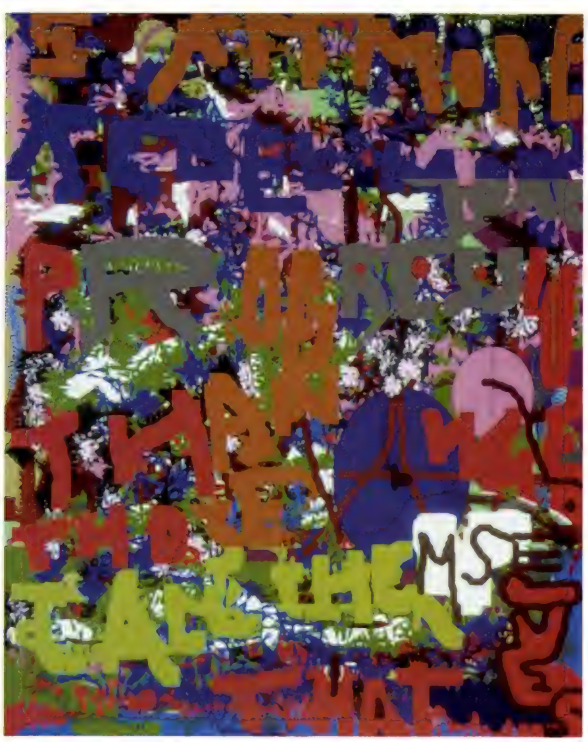
Craig Roland
University of Florida

Diane Schwartz
Northwestern University Medical School

Susan Weinstock
Mt. Dora High School

Eric White
Binary Arts



Rob Knight, *age 17*
Florida State University School
Tallahasee, FL USA

TEACHER
Debi Barrett-Hayes

HARDWARE/SOFTWARE
Macintosh Quadra 700
Painter

Nancy Ingle
Jacquelyn Ford Morie
Christopher Stapleton

T H E B R I D G E

The Bridge is a unique section shared by SIGkids and The Edge at SIGGRAPH 94. It comprises two types of exhibits: those designed for kids and those designed by kids.

The works designed for kids are created by seasoned researchers who have focused their work on the needs of youth. Their work brings applied technology not only to solving some very real-world problems but also to developing effective teaching tools. The Personal Communicator narrows the communication gap between hearing and deaf children in schools. Virtual Cell Biology teaches compassion along with the basic cellular functions. And Triangle Tiling unveils the wonders of non-Euclidian mathematics in a visually rich and intriguing way.

The second type of work included in the Bridge is done by student researchers who are only just beginning to stretch their wings in the world of science and imaging. These works display a remarkable level of sophistication and promise. The primary focus is games, which motivate students to learn advanced concepts like computer science and effective presentation techniques. The students also gain valuable real-world experience working with mentors, as well as with the latest technology.

An undergraduate student group, the "Toy Scouts," has created a series of full-body immersive games, and University High School students working alongside them have developed their own unique game – CyberSurf.

These Bridge works emphasize the human spirit – by and for kids of all ages.

Nancy Ingle
SIGkids Chair

Jacquelyn Ford Morie
Christopher Stapleton
The Edge Co-Chairs

CyberSurf: VR Game Creation

Mentoring is an ancient process. Its history stretches back to the Middle Ages, when experienced workers began passing their skills on to younger novices. Today, this training method has many shortcomings, primarily because huge volumes of information must be passed along to the trainee. Still, the concept of gaining knowledge and skills directly from an accomplished practitioner retains some merit.

In a traditional school situation, the master has always been the teacher, but most teachers cannot keep up with the exponential rate of technology development. This raises an important question: can something as complex as virtual reality be taught on the high school level? Utilizing mentoring techniques, we have shown that it can.

CyberSurf: VR Game Creation is an adaptation of the mentoring concept in high school instruction. Robert Catto, an instructor at University High School, Orlando, approached Michael Moshell and Dan Mapes of the Institute for Simulation and Training at the University of Central Florida about using the Toy Scouts (an undergraduate virtual reality research team) as mentors for high school students. They proposed that undergraduates proficient in different areas of VR convey their knowledge to a group of high school students, who in turn would teach other high school students and ultimately middle school students, thus transferring knowledge through multiple teachers instead of just one.

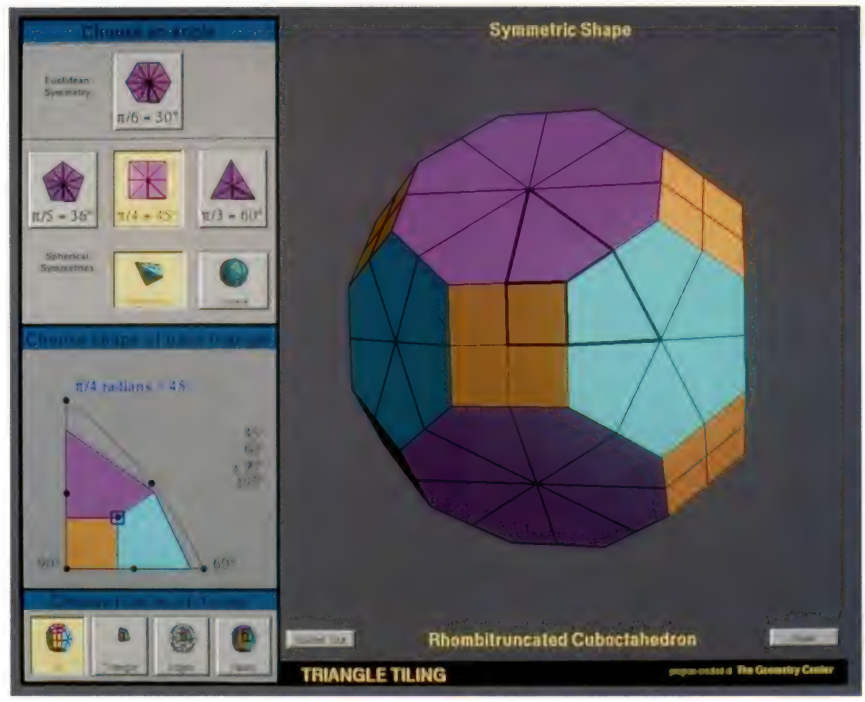
The result was an immersive VR game: CyberSurf. The game's foundation source code was developed by the Toy Scouts. University High students helped with physical metaphor authoring and construction of initial models. Several skills were passed on to the younger students, including: C programming, 3D modeling, applications of World Toolkit software, texture mapping, and development of physical models.

At SIGGRAPH 94, University High students test the concept's validity by mentoring SIGkids participants. The mentors teach modeling skills using the OGRE software package and visualizing the resultant models in REND386. If participants develop a working VR world they will be able to import it into the CyberSurf environment and fly through it.

Robert Catto
University High School

SPONSORS
Institute for Simulation and Training
University of Central Florida

Toy Scouts
Dan Mapes
Robert Catto
Michael Moshell



Triangle Tiling

Triangle Tiling is a collaboration between the University of Minnesota Geometry Center and the Science Museum of Minnesota. Through interactive graphics, it allows visitors to explore the connections between symmetry groups, tiling, the Platonic and Archimedean solids, and non-Euclidean geometry.

The Platonic solids have been known for millennia, while non-Euclidean geometry is on the cutting edge of current mathematics research. In the 19th century, mathematicians showed that it was possible to create consistent geometries in which Euclid's Parallel Postulate was no longer true. Absence of parallels leads to spherical, or elliptic, geometry; abundance of parallels leads to hyperbolic geometry. Two-dimensional spherical geometry is used in real-world situations such as determining the shortest path for an airplane flight between two cities.

In the past 30 years, solid Euclidean geometry and spherical geometry have disappeared from most high school curricula, leaving only abstract plane geometry. The Triangle Tiling collaboration attempts to reintroduce ideas from spherical and solid geometry to remind people of the reality and intuitive nature of mathematics.

Triangle Tiling was designed for the science museum environment, where visitors range from very young children to adults, so it is accessible to the casual browser, but it also has deep mathematical content for the more serious investigator. A Silicon Graphics workstation and custom software are used to communicate mathematical concepts traditionally reserved for advanced undergraduate or graduate mathematics students.

The exhibit aims to convey the richness, diversity, connectivity, depth, and pleasure of mathematics. Imagination, an essential part of mathematics, means not only the faculty which is imaginative, but also the faculty which calls to mind and manipulates mental images. The real power of computer graphics lies in its ability to accurately represent objects for which physical models are difficult or impossible to build, combined with its ability to allow the user to interact with simulated worlds. In this way, the computer serves as a window into theoretical worlds, allowing us to see and experience mathematical phenomena to an extent impossible in the "real world."

Exhibit Content

The most basic idea of the exhibit is that space can be tiled with triangles. The exhibit interface consists of control panels with mouse-activated buttons, a base triangle interaction window, and a large window with a tiling made from many copies of the base triangle. In the simplest case, the

base triangle is flat and the tessellation is a flat plane, which rotates with the glass ball direct-manipulation model by dragging in the large window. Dragging the "bending point" in the base triangle window results in kaleidoscopic pattern changes in the large window.

By using one of the control-panel buttons to increase the size of just one angle of the base triangle, the user can gently enter the world of non-Euclidean geometry. The base triangle can no longer exist in a flat plane, and so becomes bent. The user can drag around the bending point, which is where the colored pieces of the triangle meet. The formerly flat tessellation has become a closed shape, called a polyhedron. Moving the bending point in the base triangle window changes the shape of the polyhedral tiling in the large window. At the special places marked with black dots, the shapes are the Platonic or Archimedean solids, which are very symmetric. When we arrive at one of these shapes, its full name appears on the screen in text and is spoken aloud through the external speaker.

Spherical geometry is the name for the non-Euclidean geometry in which the sum of the angles of a triangle is greater than 180 degrees. The control panel allows the user to choose between two ways of representing spherical triangles: as bent triangles, which produce a polyhedral tessellation, or as curved triangles, which form a round ball when tiled. In the curved case, moving the "bending point" produces color changes on the surface of the sphere similar to the case of the flat Euclidean plane, instead of changing the actual shape of the tessellation.

Exhibit History

One of the exciting aspects of this exhibit is the successful collaboration between the informal science education community of the Science Museum and the mathematics research community of the Geometry Center. The Geometry Center is the National Science and Technology Center for the Computation and Visualization of Geometric Structures, whose mission is to foster research in geometry and communication of geometric ideas using modern computation and visualization tools.

Software originally designed by Charlie Gunn for use in a research environment was customized for use by the non-mathematical public. Exhibit developers, graphic designers, and computer scientists worked together to create an intuitive interface that blends aesthetic and functional considerations to guide exploration of the subject matter. The exhibit is seen by roughly 10,000 people per week and used by perhaps 25 percent of that number. It has received an enthusiastic reception from a wide range of museum visitors.

The Triangle Tiling software will run on any Silicon Graphics Iris and is built on top of Geomview, the Geometry Center's general-purpose public domain interactive 3D viewer. The interface of the Triangle Tiling module hides most of the functionality of Geomview, which can be invoked only if keyboard access is allowed. Both Triangle Tiling and Geomview are available on the Internet free of charge via anonymous ftp from geom.umn.edu.

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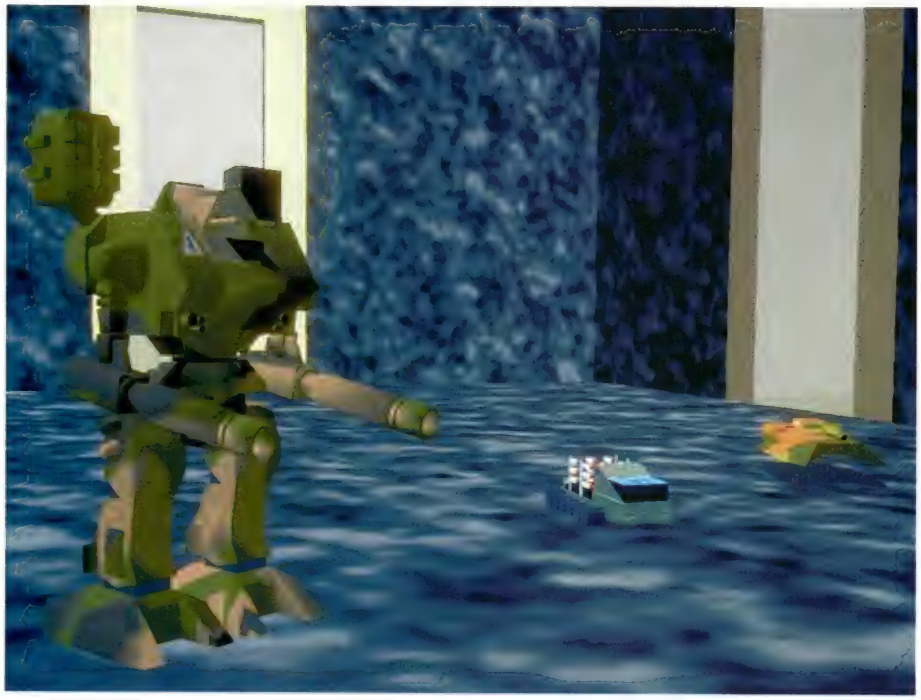

The "Toy Scout" Arcade

A series of interactive games, developed by the "Toy Scouts," explores the use of full-body motion in virtual environments (VE) instead of more passive 2D game interfaces. Spatial and temporal calibration issues are addressed in an attempt to bring the player further into the games. Some of the games use only viewpoint movement for dodging, searching, and walking; others use hand-to-eye coordination for throwing, shooting, and manipulation.

In NoseBall, you bounce a ball off your head to hit targets on walls. In Wormhole, you raise, lower, and otherwise contort your body within a volume in order to navigate a 3D maze. Ricochet, a whimsical shooting-gallery game, and Virtual Darts bring the hands into the interface for throwing and aiming tasks. A spatial guessing game called Probe uses only variable pressure applied to the fingertip when it is passed through a volume in order to determine the shape of a virtual object.

Collectively, these games form a "Toy Scout Arcade" as part of the bridge between SIGkids and The Edge.

The Virtual Reality Research Team – aka "Toy Scouts" – has been creating and demonstrating VE applications and games for over two years under the sponsorship of the Institute for Simulation and Training at the University of Central Florida (IST/UCF). The Scouts have been guided in these endeavors by IST researcher Dan Mapes, who hosts Friday-night meetings in the IST Visual Systems Lab. Most of the team members are undergraduate UCF students, but they are also joined by professionals from the local entertainment and design industries as well as by students from University High School. The result is a unique dual mentoring process and an extremely creative and productive environment. Students gain real-world research experience and professionals gain first-hand knowledge of the technology. All projects have been completed by volunteers without external funding. Space and equipment have been graciously loaned by various ongoing projects within the Visual Systems Lab.

Potential future impact

The use of full-body motion is an aspect of the VE interface that is relatively new to the area of real-time simulation. Traditionally, simulators require the participant to be seated. There are many examples of full-body interactions that require the use of special motion bases like treadmills, surfboards, and even hang gliders. There are very few that really attempt to isomorphically map human movement directly into the game to encourage natural spinning, ducking, dodging, grabbing, or throwing behaviors. It is this one-to-one mapping of movements that makes the full-body games of the "Toy Scouts" so intuitive and intriguing.

The lessons learned by developing successful game interaction techniques can also be transferred into more commercial applications. For example, the full-body searching techniques used in games can be applied to data acquisition tasks. The level of calibration required for adequate human performance in a game can only improve data visualization and direct manipulation applications like modeling. Games can focus on aspects of the VE interface which have no apparent usefulness today but may open the door to unexpected and valuable commercial adaptations in the future.

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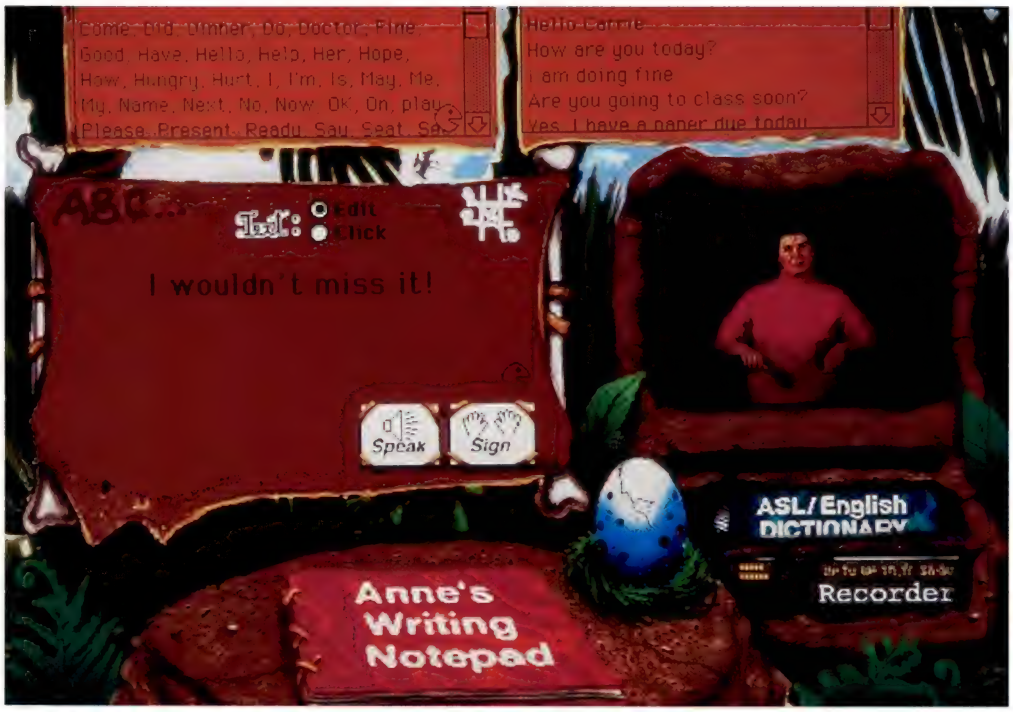

The Personal Communicator

The Michigan State University Comm Tech Lab has developed a Personal Communicator to run on Macintosh Powerbooks. It is designed to:

• Provide a medium for social interactions between deaf children and their hearing associates using sign and speech synthesis.

• Contribute to a deaf child's language proficiency in English and American Sign Language (ASL) through interactions with a readily accessed multimedia dictionary/thesaurus.

• Contain word processing capabilities to facilitate the writing of dialogue journals.

Currently, the Personal Communicator contains a word-to-sign and sign-to-word referencing system of 2000 digital video ASL signs. Another 2000 words will be added in 1995.

The isolation of deaf children in the public school system is well documented, as is their reluctance to interact with their hearing peers. One major obstacle to their social integration is the inability of deaf and hearing children to communicate effectively. Other obstacles include negative attitudes or uncertainty about integration on the part of teachers. Funded by the U. S. Department of Education, the Personal Communicator is designed to expand the opportunities for deaf children to become active participants in classroom discussions and casual conversation.

Project Description

The four primary interlinked components of the Personal Communicator include the Communicator for communication with others (users can construct phrases and sentences by clicking on or typing in words), the Dictionary for looking up word meanings and signs, the conversation Recorder for

accessing the previous week's conversations, and the writer's Notebook for writing, saving, signing, and speaking stories and correspondence.

Both form and functionality are important in the design of the Personal Communicator. The attempt is to create software that is appealing and fun to use, and that helps motivate deaf children and their hearing peers to use it for communication.

Children can choose from an expanding set of graphical user interfaces, all of which share identical functionality. So far, three screen designs have been crafted: a basic classroom environment, the default and the easiest environment for learning; "Jurassic Communicator," featuring a prehistoric, cave-person look and feel; and "Space Tech," a futuristic spaceship environment. Both sign and speech synthesis are included instead of only speech synthesis because the Personal Communicator is not just a talking computer but a tool which, it is hoped, will help deaf and hearing children appreciate the value and richness of ASL as well as spoken and written text. In a sense, the Personal Communicator is a celebration of the many forms of language that apply to the communication and learning needs of deaf children.

The Personal Communicator has the potential to affect education and socialization of deaf children in several ways. First, it will directly influence the English and ASL vocabularies of deaf children, which is a critical component in the development of reading and writing skills. Improved vocabulary should lead to greater proficiency in interpersonal communication. Improved communication skills will provide deaf children with more tools for initiating and sustaining a conversation with non-deaf peers and associates. As deaf children participate in more interpersonal communication, they should obtain more exposure to functional linguistic experiences that will expand their opportunities to develop a variety of language structures.

Second, the project will directly affect the sign-communication skills of deaf children's hearing peers who have access to the Personal Communicator. The possession of sign communication skills by hearing students creates new opportunities for social interaction for both deaf and hearing students. Increased opportunities for social interaction may result in better social and language skills for deaf children. Language is an important component of social interactions, and meaningful social interactions with hearing peers will give deaf students more opportunities to experiment with the English language and consequently to internalize some of its lexicon and syntax features.

Third, teachers' attitudes toward mainstreaming of deaf students may be indirectly influenced by their perceptions of improvement in the communication skills and social interactions of deaf children, and by hearing children who are learning signs. Teachers who have positive attitudes toward mainstreaming may influence the way other teachers in a school feel about deaf students.

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Virtual Cell Biology

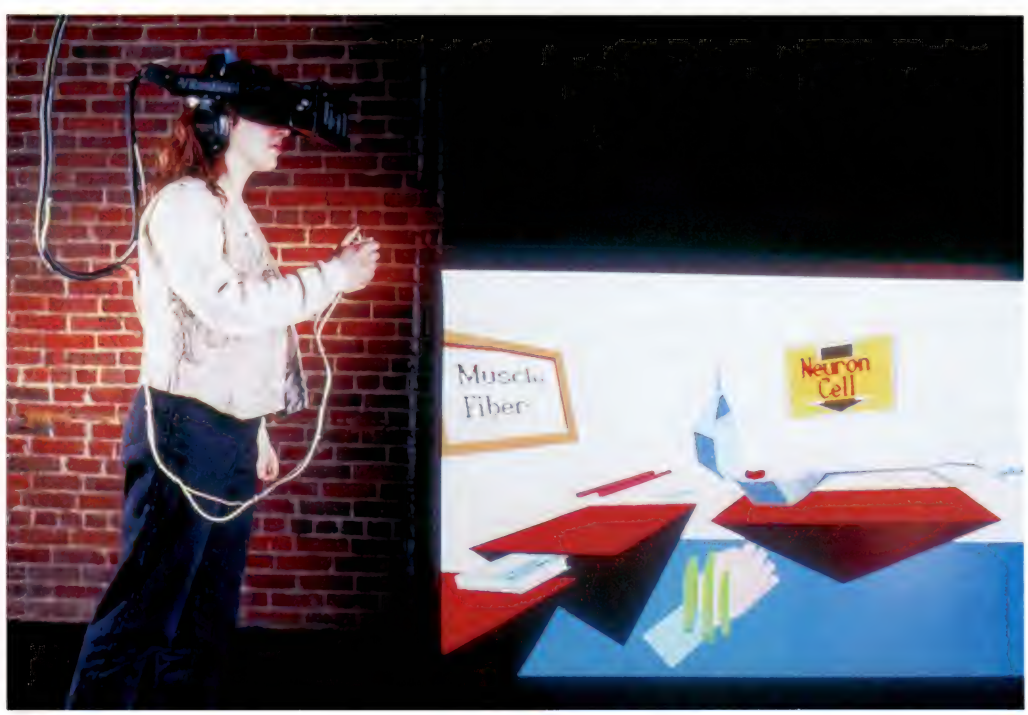
Imagine shrinking to microscopic size and experiencing cell biology first hand. Imagine experiencing the parts of a cell not as static stains on slides, but as dynamic interactive objects. Imagine building a cell by hand and seeing it function. Virtual Cell Biology makes all this possible.

This experimental virtual world for teaching cell biology at The Computer Museum in Boston is part of a project to test whether immersion in a virtual world makes a measurable difference in how well people learn scientific information. Cell biology was chosen because it involves complex spatial interactions and is inherently three-dimensional. In this virtual world, the user brings a child to life by building a neuron, a muscle cell, and an intestinal cell.

The system allows the user to learn through discovery. The user physically walks around in the virtual world, building each cell by physically picking up virtual organelles and placing them in the empty cell. 3D animation and spatially located sound are liberally used to make the world rich and informative.

The user enters the virtual world by putting on a head-mounted display and picking up a hand tracker. The interaction with the virtual world is very simple – reach out and grab objects, walk to where you want to put them, then let go. The physical motions of reaching and walking in the real world are mapped directly into motion of the virtual hand and viewpoint in the virtual world. There is no need to learn gestures, or how to use virtual portals or other devices. Even so, most people need to experiment with picking up virtual objects and moving in the virtual world before they are ready to learn about biology. For this reason, users begin the virtual experience in the grab-and-carry room.

The grab-and-carry room contains an empty chair and a small cube that is spinning in mid air. The cube asks to be carried to the chair. When the cube is put on the chair, it disappears and is replaced by a limp child. The child explains that he needs neurons to



think with, muscle cells to move with, and intestinal cells to digest food for energy. Then the child asks the user to grab the child's arm or leg to make a muscle cell, stomach to make an intestinal cell, or head to make a neuron. When the user grabs a part of the child's body (such as the head), the user is drawn into a room containing an empty cell for that part of the body (for example, a neuron). Around the room are tables of organelles such as mitochondria, muscle fibers, and a nucleus.

When the user enters the cell room, the cell explains what it does and what it needs. For example, the neuron generates electrical signals that jump the synapses to other neurons. It needs energy to generate the signals and enzymes to conduct them across the gap. The user builds the cell by walking around the room, picking up organelles, and putting them into the cell. There is a book located next to each organelle. When the user opens a book, a 3D animation appears over the book showing what the organelle does, and a digitized voice explains it in detail.

When the user puts an organelle in a cell, one of two things happens. If the cell needs that organelle, the digitized voice explains how the organelle works with the other organelles to meet the cell's needs. If the cell does not need the organelle, the organelle pops out of the cell, and the voice explains why the organelle is not needed in that particular cell.

When the cell is complete, it asks the user to grab its top to start an animation. When the user grabs the top of the cell, the cell closes, and the room disappears. Along with its neighbors, the cell goes through an animation showing how the cell functions in the body (for instance, sparks jump from neuron to neuron). When the animation is finished, the user returns to the child room and the child thanks the user ("I can think now!").

The child becomes more animated as each cell is completed. After the neuron is done, for example, the child's head wakes up and watches the user alertly. When all the cells are assembled, the child tells the user: "I feel GREAT!" and the world exits with a fanfare of digitized trumpets.

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Jacquelyn Ford Morie
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T H E E D G E

"Come to The Edge," he said.
They said, "We are afraid."
"Come to The Edge," he said.
They came.
He pushed them...
And they flew.
Guillaume Apollinaire

You are on the edge of a cliff; before you lies a universe of unknown possibilities. Forget what you know and give yourself permission to explore the potential of what could be. Using new interactive technologies as wings, The Edge takes flight – past familiar boundaries into the realm of dreams and ideas.

In The Edge, preconceived ideas are challenged and new connections emerge. The contributing researchers of this exhibit – a new breed of both artists and scientists – constantly create and recreate the uncharted seas they explore, and then let the results of their experimentation point the way for others to join the journey.

Instead of simply demonstrating the latest technological advances, The Edge is designed to introduce the human element, celebrate the essence of the creative mind, and be a catalyst for new ideas. As they use these interactive technologies to seek out their own dreams, attendees join an experiment in how researchers and attendees can become partners in the creative process. In this open laboratory setting, both groups obtain valuable feedback on how we, as humans, interact, learn, think, discover, and communicate.

The Edge is also a social experience. It is a journey that can be experienced on many different levels. Browse through these exhibits, and let yourself be stimulated by the wide range and depth of ideas. Interact with this vanguard technology by trying it firsthand. Attend an open "springboard" forum to discuss how these inventors were inspired and came to their conclusions. Share the vision of scientists and artists in one-on-one discussions. Explore the background of experiments more deeply through electronic interactive kiosks. Contribute your opinions through a video soapbox. Find a comfortable place to discuss your ideas with others. Or just sit back and enjoy the stimulating environment of light and vision.

As the organizers of The Edge, we invite you to become a visionary partner in this unique open laboratory. Join us in dissolving the lines between nascent ideas and their physical realities. It is no coincidence that this technological playground is located next to the SIGkids exhibit. Just as children test their capabilities by constantly climbing to ever higher plateaus, we ask those who experience The Edge to go beyond what they know and to become inspired by what could be.

Come play. Come dream. Come explore. Come to The Edge and see how high you can fly.

Jacquelyn Ford Morie
Christopher Stapleton
SIGGRAPH 94 The Edge Co-Chairs

Will The Edge succeed?
Only if it pleases you, or provokes you, or inspires you.

Are you ready to step out on The Edge?

Contrary to popular belief, The Edge is not cutting. It is, in fact, rather warm and fuzzy. So warm that it melts the boundaries between art and science, between academia and entertainment, between the artificial and the actual. Fuzzy because The Edge is literally a touching experience, one in which you get to lay your hands on some tomorrow-bound interactive computer applications and feel out scads of innovative ways to use both old and new tools.

Just don't let words like "applications" and "tools" sway you into perceiving The Edge as a serious place. The Edge is a virtual playground, where the human spirit toys with digital technologies!

The SIGGRAPH conference and exhibition focus on new technologies for you to experience, while the Edge focuses on new experiences enabled for you by technology. Indeed, the Edge even dares to redefine the term "enabling technology." Usually, this term refers to a technology that makes another technology possible. As illustrated by Howard Rheingold in his book *Virtual Reality*, dynamos and incandescent bulbs served as the enabling technologies for the electrified illumination of the world. Out on The Edge, though, an "enabling technology" is that which allows such forces as dynamism and incandescence to exist, which in turn enable illumination – albeit more metaphysical than electrical.

The Edge aims to illuminate many new means of expression, celebrating interdisciplinary interface-lifts that rejuvenate the classic fields of study – biology, genetics, mathematics, evolution, anthropology, and architecture, to name but a modest bunch. And speaking of the classics, those who are environmentally aware will notice that the design of The Edge is influenced partly by natural history museum, partly by amusement park, and partly by the ancient Chinese spatial design practice of feng-shui. Feng-shui followers know the importance of an environment's ability to appeal to the array of human senses. Likewise, and lifewise, The Edge serves up fresh feasts, not only for the eye, but also for the soul, for the whole person, with a melange of rich material to hear, touch, and smell – to *experience*. The Edge is dedicated to experience in all its forms and intensities.

The Edge is as experimental as it is experiential; never before has an exhibit or gallery such as this been featured at a SIGGRAPH conference. Will The Edge succeed? Only if it pleases you, or provokes you, or inspires you. In presenting the wide variety of contributions to The Edge, the planning committee sought to showcase new advances in human capabilities and perception, to emphasize the applications, content, and context (wetware) over the hardware and software, to feature innovative, unusual visual, auditory, haptic, and multisensory displays, and to enhance the process of human communication and collaboration through experiential technologies.

The Edge has one other primary goal, perhaps its most critical: The Edge provides a means, and a place, for SIGGRAPH attendees to get up close and personal, not only with the applications but also with the people and ideas that made those applications possible. That's why The Edge is designed as an open laboratory, an Olympic-size thought pool, complete with a springboard for interactivists, virtual world-builders and cyberspace architects to meet with visitors for face-to-face feedback on works in progress. An invention is never truly tested until it is placed in the hands of those who will push it to its fullest potential. In The Edge, the technology is there to be tried and tested to its fullest.

Come, dance on the Edge. Explore its nooks. Push on its crannies. Greet its denizens. And have a real good time.

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A-Volve
A real-time interactive environment

A-Volve is an interactive environment where visitors interact with virtual organisms in the real space of a water-filled glass pool. Using a sensor pencil, they draw the profile and shape of any possible form onto a monitor screen and create three-dimensional organisms. The organisms are simultaneously transferred and displayed as three-dimensional creatures in the water of the pool, where they are immediately "alive." They move and swim, and they can be modified in real time.

These virtual creatures are products of the rules of evolution and are influenced by human creation and decisions. They are sensitive to hand movements in the water, and they react to human behaviour. Visitors can catch them, modify their forms, and communicate with them in real time. When it is "touched," a creature will avoid the hand and try to flee. Sometimes, it will come back to "play". Each creature moves, reacts, and evolves according to its original design, so it creates unpredictable and always new life-like behaviour. Since the organisms capture the slightest movements of hands in the water, their form and behaviour change constantly.

Specific algorithms developed by Mignonneau and Sommerer ensure that the virtual creatures move very smoothly and animal-like. None of the forms is pre-calculated; they are all "born" in real time by visitor design, and they achieve their behaviour by moving in the real-water environment. If nobody is creating any forms or interacting with them, the creatures die and disappear.

These living, reacting organisms also interact with other organisms created by other visitors. Two forms can merge and create a new form, which combines the genetic codes of its parents. Visitors can promote the "birth" of a new organism. With their hand movements in the water, they can "join" two organisms by trying to bring them near to each other. When they succeed, a new organism is born. The new creature, which carries significant characteristics of both parents, lives in the pool, where it interacts with its environment and other forms.

The drawing device, which creates new forms, can be used by only one person at a time, but several other visitors can interact with the creatures in the pool as new creatures are created. At the same time, visitors interact with each other through the various virtual organisms.

In this virtual environment, the visitor is part of the evolutionary system, a partner of the virtual organisms, and a creator and promoter of "artificial life." Following the laws of evolution and creation, A-Volve is open to all possible modifications and selections. It reduces the borders between real and unreal, by connecting reality to "non-reality." Water, the medium for this artificial life "pool," is the metaphor for birth and basic evolution.

A-Volve is part of a continuing investigation of natural interfaces and complex interactivity. Similar to "Interactive Plant Growing" (© 1992, Sommerer & Mignonneau), where visitors could interact with real plants and influence and control the growth of virtual three-dimensional plants, A-Volve deals with the definition of "life" and the connection between "reality" and "non-reality".

Both installations reveal human perception of reality by interpolating between both constitutions of environments ("real" and "non-real"). Complex natural interfaces (like plants or water) ensure a new approach to perception by asking: "What is Life?". In both installations, complex systems like "human and plants" and "human and animal-like creatures" are connected through living interfaces, producing a complex "artificial biotope" that represents the interaction between visitors and their environment.

Another important aspect of this work is the issue of "individuality" as a main constitution of life. A-Volve connects the individuality of the visitors to the individuality of the artificial creatures, creating a pool of artificial individuals in a complex system of interactions. The individuality of the virtual creatures is, so to speak, a direct interpretation of the relationship between visitors and their perception of artificial reality. The creatures will always be different, depending on how visitors create them and play with them. Direct and simultaneous communication between creatures and visitors creates a pool that could itself be considered a "living system."

By closely connecting the real natural space of the water to the unreal virtual space of the creatures, A-Volve minimizes the borders between "real" and "non-real," creating a further step (after "Interactive Plant Growing") in the search for "natural interfaces" and "real-time interaction."

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ARCHiTEXTURE by SUPREME PARTiCLES 1994

ARCHiTEXTURE is an interactive image/sound/room installation using real-time image and sound processing. Through the architectural and technological setup, the viewer is confronted with a computer-generated "plasmatic being." Both visual and accoustic perception are stimulated.

Implementation of a "brainlike" software structure in virtual reality environments frees the interactive process from its 1:1 transmission of information. The brain creates a history and uses the past to assemble the future. It also acts in a destructive manner: it can forget useless information and substitute it with meaningful data. The connection/interfacing between sound and image creates a double plasma: the visual plasma and the accoustic plasma. Real-time computation of both media requires sophisticated technology.

Setup

In the middle of the room is a pneumatic projection screen that can be controlled with a computer. In front of the projection screen, a circular pattern is painted on the floor. This is the center of action and interaction.

Interaction

1. Image

As the viewer steps into the room, the screen shows the image from a camera: a wide-angle shot of the space. As if in a mirror that illuminates hidden structures, the viewer is shown crossing the room. When the viewer steps into the middle of the circular pattern, two shots are made from two different angles with two different focal lengths. These images are transformed into 3D models and interpolated in real time by the specially designed 'plasmatic' software. Liquid, organic images are created. Then the image is put back as a texture over these objects and, through further software-based manipulation, is turned into PLASMA. The (software) mirror starts a life of its own. The "reflection" expands, bulges, and transforms continuously. At the same time, the pneumatic projection screen transforms physical flatness into 3D space to support the "plasmatic" effect.

2. Movement and Sound

Confronted with a fragmented self-image, the viewer acts to correct the reflection. As the viewer moves, the PLASMA starts to react. Not only visual patterns, but also interpolated speech is created. A microphone collects all speech and noises in the room, storing them in small units in the computer's memory. There they are "soundmorphed" and interpolated into an artificial language that consists not of concrete messages but of sound with a strong emotional value, at least as long as the viewer is moving in a hectic, excited fashion. As the viewer changes to slower, smoother movements, the PLASMA changes, too. It starts giving off pieces of sound that were stored earlier. What is more, the artificial being is no longer reduced to passive imitation of the viewer. It starts moving according to its own laws of

interpolation, and as the viewer's movements become more coordinated and smoother, the reaction of PLASMA is no longer mirror-like. Now it is life-like. And it starts playing the active part, "talking" to the viewer and using its "brain" to construct two-way communication.

Software

1. Visual

The software transforms 2D video images into 3D computer models that are further transformed via local growth, bubbles, texture gravitation, and texture interpolation.

2. Audio

An organic sound ambient is generated via interpolation of frequencies (soundmorphing), a 3D sound system with 8-12 speakers depending on the room, 3D active MIDI-processes, MIDI-evolution, MIDI-gravitation, and digital signal processing computer-controlled effects processors.

Bio-Grid Library

All functions are designed in order to create organic behaviour among audio data, digital images, and 3D coordinates. All modules can be connected; the same functions can be applied to either audio, images, or coordinate-space. The two-dimensional video images are transformed into three-dimensional coordinate space. In this way, an additional space/time dimension is introduced to the system – a topography of the image. Unlike the organisation of images in time, this opens space for image internal metamorphosis in the space/time dimension. The information of the image can therefore be freed from its static representation and transformed into states with enhanced or reduced complexity. The additional inheritance of external information (audio data, etc.) allows image behaviour to be controlled through external parameters.

Methods of the "PLASMATIC"

Software Order:

Chaos – gravitation, dynamics random walk, worms

Life algorithms – transformation from 2D into 3D, external sound-specific control, manipulation in color-space

Creation of subpatterns / substructures – texture mapping, texture animation, paint and wax-effects, 2D / 3D warping

Disintegration of objects into particles – light animation

Digital signal processing applied to – 3D objects, 2D images, sound, coordinates / Z-buffers

Sound-specific controls – control of dynamics through audio input, sound mapping: mapping of audio data onto 3D objects, sound-driven image processing

Sound-specific parameters – amplitude, frequency, average, minimum, maximum, variance

MIDI-specific parameters – pitch, velocity, xyz coordinates, instrument/sound choice

Sound generation – mapping of 3D coordinates onto MIDI parameters, mapping of 3D coordinates onto 3D speaker-matrix, use of 3D coordinates as envelopes and timelines

Metamorphosis/interpolation of – 3D objects, sound (soundmorphing), images/colors

Interpolation with the help of – gain/bias functions, fractal algorithms, gravitation/magnetism.

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SMDK: Simulation-Space Mosaic of Mobile Data Sounds

SMDK is a cross-disciplinary project by Knowbotic Research (KR+cF) that results from an exchange of working techniques among media artists, computer musicians, and computer scientists. The interactive environment consists of a database containing sounds from all over the world. Based on their characteristics and simple artificial-life rules, the sounds become mobile elements (agents) and form a self-organizing system comparable to a simple cultural community.

A visitor equipped with a tracking sensor can interactively explore the system in a walk-in room. The speed and type of the visitor's movements trigger sounds and influence the organization of the sound elements by manipulating their duration, volume, and direction. Through a small head-mounted monitor, the visitor receives textual information that aids navigation inside the virtual sound space. A computer-generated visualization of the continually changing system, the actions of the visitor, and their bearing on the system can be observed by an audience on a large screen in a separate room.

Realization

The Open, Self-Organizing Database

For this project, Knowbotic Research sent out an international call for participation about two months before the exhibition. The collected sound samples (personal, acoustically formulated attitudes towards the world) submitted via computer networks like Internet and CompuServe, or on ordinary audio and DAT tapes, are analyzed both automatically and manually and given 10 different characteristics that reflect acoustically distinguishable features. Next, the sound samples are placed in a database, where they become mobile elements (agents) in real space and their equivalent in virtual space. The behavior of the entire system is determined by the characteristic group forms and by means of a simple artificial life system. There are 10 different groups based on the characteristics assigned to the sound data. Equipped with the three basic degrees of freedom, the agents organize spatially in sound groups that represent one characteristic each, forming an organism that continuously restructures itself. For example, agents may form a group or join a group if they have the appropriate characteristic, or float in space as free agents.

Visitor Navigation in the Action Space

This dynamic system is made accessible to the visitor in the physical action space, part of a larger, darkened room outlined by fiber-optic light cables that show the base boundaries of the space. As a visitor enters the action space, an ultrasonic tracking system spots the visitor's presence and transmits it to the virtual space. The visitor is equipped with an ultrasonic sensor attached to one hand and a small monitor mounted in front of one eye that provides textual

information via a radio link to the data space. This "private eye" shows directions for contacting the sound groups and information about the characteristics and quantity of groups located within a certain range of action.

Opening the System: Real-Time Concert
A sensitive zone in the virtual space surrounds the position of the visitor's hand. Through this zone, the visitor's movements activate the original sound information and "compose" sounds by manipulating the duration, volume, and direction of each element. The visitor becomes part of the system, influences its complex behaviour and builds new connections.

Reception by Outside Observers
A large screen located outside the action space displays a rendered, real-time outline of the virtual organism which, in turn, is described in the action space in acoustical and textual terms only. The computer visualizes the overall system and the dialogue between the visitor and the database. Each of the 10 possible groups has its own geometric representation. Once an agent joins a group it adopts the geometric representation of this specific group. The system also shows the current position of the visitor and highlights sounds or agents that are being activated.

Concepts
The chaotic basic structure of SMDK, the self-organization feature, real-time composition and fragmentation of public sound material, continuous visualization of (mathematical) processes, and the openness of the entire system to the outside world through data networks represent a complexity that challenges the visitor to construct his or her own orientation system within an interactive database.

Public Knowledge Space
The visitor enters a "black space," a completely unfamiliar situation. Through concurrent active presence in the real space and the virtual space, the visitor empirically recombines the virtual spatial composition into incalculable new contexts of the underlying information volume. The resulting dynamic sound mosaic reconstructs the real space ("real virtuality"). Departing visitors leave behind specific imprints of their experiences, which remain intact until the system is reactivated.

Technoid Aesthetics
Visitors to KR+cF's environment move in a communication field in which new forms of language have not yet emerged. Development of a nonverbal form of individual knowledge generation draws on aesthetic experience in various encoded public data fields (acoustic, textual, graphical, and numerical). The SMDK information system, too complex to be fully comprehended, represents a shift in delimiting boundaries of technologically supported, ordered systems. It provides an opportunity to expand our perception and arrive at a critically reflected, technoid-aesthetic experience.

Knowbotic Research KR+cF
KR+cF focuses on interdisciplinary projects involving the de- and re-construction of public information systems, unusual forms of perceiving data structures, and new knowledge-generation approaches. KR+cF's work is based on immediate confrontation of new artistic strategies with methods of perception and discovery used in other fields of knowledge.

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The project has been developed at the Academy for Media Art Cologne with the support of the Ministry of Culture, Austria.

CyberFin™

In partnership with the Cancun Convention Center, the AquaThought Foundation is developing CyberFin, an immersive dolphin-encounter simulator that will bring virtual dolphin contact to a massive audience.

CyberFin transports the user's point of perception into an underwater location populated with friendly and inquisitive dolphins. State-of-the-art virtual reality and neurotechnology are employed, making this a most engaging location-based-entertainment (LBE) attraction. The content, dolphin contact, is attractive to men, women, and children of all ages.

A stereo visual/aural recording created with the Underwater Telepuppet drives the various sensory output modalities of the CyberFin platform. This is a non-interactive, "canned" experience in its initial implementation. The platform itself is based on a VibraSonic ACV-8000 total sensory stimulation device. The participant lies on a liquid-crystal-filled mattress designed to distribute stress evenly against the body, closely approximating the feeling of floating in water.

The patented Liquid Crystal Floating Transducer Platform housed in the VibraSonic device "base drives" the participant's entire body with a stereo hydrophone audio signal. A neurophone is employed to completely simulate the feeling of massive acoustic energy perceived while underwater with a dolphin and its echolocation system. The neurophone transduces the incoming stereo hydrophone audio signal directly onto the participant's nerve pathways. This form of direct sensory input actually reproduces the mechanical skin-to-water coupling which occurs during a dolphin encounter. A CRT-based stereo viewer is lowered into position directly over the participant's eyes to provide high-resolution, 3D visual input. All 3D audio/visual content is synchronized when recorded (within the Underwater Telepuppet) to assure proper playback.

The pre-show introduces you to a talking dolphin, shows dolphins playfully interacting with people of all ages, describes dolphins' remarkable physiology and intelligence, and presents heart-warming stories about the altruistic and loving nature of these beings. Then you lie down on the table and wait while an attendant adjusts the stereo-optic display and attaches the neurophone electrodes.

The bed begins to gently undulate as a 3D underwater scene fills your vision. Suddenly, you hear and feel an intense explosion of sound sweeping around you and through you. As you try to orient yourself to the direction of this strange and wonderful sound, a dolphin darts past you, giving you a comforting glance with his soulful eye. As the experience continues, you playfully encounter each of six dolphins and join their pod in a high-speed race around a beautiful reef. The five-minute experience ends with a grand and triumphant farewell as the six dolphins form a circle around you then skyrocket out of the water in a synchronized movement.

This virtual experience is truly a roller-coaster ride for the mind. The application of VibraSonic and neurophone technology delivers unsurpassed sensory realism. The objective is to immerse participants in the wonder, joy, and excitement of actually meeting a dolphin, so that they will leave the attraction with a greater understanding of our intelligent neighbors and an awakened interest in making contact with them.

Cancun Convention Center

The Cancun Convention Center, site of a new $100 million immersive media and virtual reality attraction, has announced a cooperative agreement with the AquaThought Foundation to incorporate dolphin-human interaction at its new facility. The agreement will merge the latest in immersive virtual reality technology with the adventure of close contact with dolphins.

Scheduled to open in late 1994, the development includes a 7,000-person convention center; a fully immersive multi-sensorial center; a 54-store shopping mall with intelligent kiosks that inform, attract, and direct shoppers; an IWerks 3D cinema with an interactive laser imaging system; a 600-foot-tall panoramic tower; and ShowScan simulated rides produced by George Lucas. The main attraction, according to Servando Braun, the project

director, is the multi-sensorial center with its virtual reality environments. The biggest challenge, according to Braun, was to find content which offered more than mindless violence. "An intense sensory experience does not dictate that higher-level intellectual functions be switched off," says Braun. "What we want for the Cancun Convention Center, in contrast to current VR amusement, is content which is both exciting and meaningful."

Meaningful content is exactly what the AquaThought Foundation has brought to the facility. "Dolphin contact is one of the most intense experiences one can have. To swim with these intelligent beings is pure joy," says David Cole, Chairman of the AquaThought Foundation. AquaThought has demonstrated, through electroencephalographic studies, that close interaction with dolphins significantly changes the neurological state of the participant. In a field of alternative medicine – only now being taken seriously by the medical community – dolphin interaction therapy has been used for over twenty years to treat severe depression, cancer, Downs Syndrome, autism, and other disorders. The new relationship with the Cancun Convention Center accomplishes one of AquaThought's long-term goals: to develop technology that allows unlimited numbers of participants to have the intense and potentially healing experience of swimming with a dolphin, without adversely affecting any dolphins.

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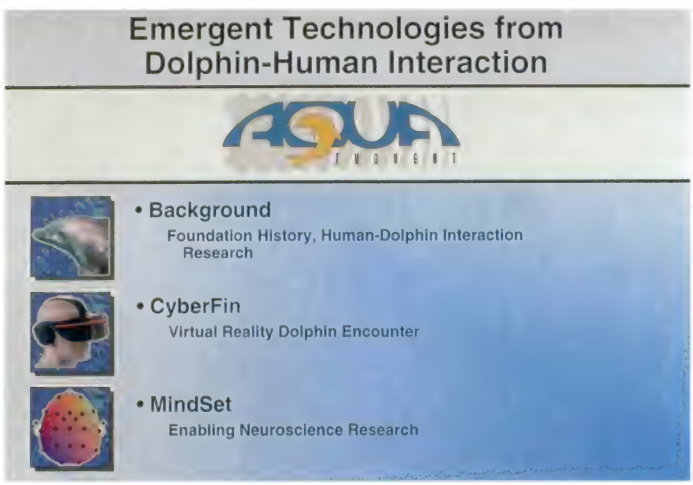

MindSet: Neurological Man/Machine Interfacing, An Emergent Technology From Human-Dolphin Interaction Research

The AquaThought Foundation's research in neurological imaging has led to the development of MindSet, a low-cost neuro-mapping electroencephalograph that makes advanced EEG research accessible. Designed for research and clinical use, MindSet incorporates the latest EEG signal analysis processes and a complete suite of standard neurological protocols. It accommodates the novice user as well, with an easy-to-use interface and a hyperlinked neurological anatomy database.

Advanced features of the MindSet system include real-time 2D and 3D topographic visualization, neurometric analysis, routine EEG study, phase coherence analysis, compressed spectral array visualization, inter-electrode interpolation, a hyperlinked neurological anatomy database, MIDIbot™ feedback, neural network feature extraction, a light and sound machine interface, and a visual programming interface for user-defined analysis (neurohacking). The MIDIbot™ tool allows MindSet users to generate MIDI commands from temporal, spectral, and spatial information within the EEG data.

As an educational resource, MindSet offers the user hyperlinked neurological anatomy information that can be accessed by clicking on a topographic montage. Potential applications for MindSet include clinical neurology, conventional and obscure brain/mind research, man/machine interface research, biofeedback, and discrete biological pattern recognition research.

The Exhibit

MindSet's primary focus in the this exhibit is man/machine neural interfacing. Using the neural-event and gesture-recognition functions, in combination with the MIDIbot™ interface, users can control a MIDI synthesizer and laser light show. Users also learn to recognize the appearance of various neurological events as they are visualized on the topographic display. EEG data are collected throughout the exhibit and complied into a QuickTime/AVI movie entitled, "Minds on The Edge" or a before-and-after topographic still compilation entitled, "This is your brain... This is your brain on SIGGRAPH." Also on display: several research projects that have been made possible by MindSet, including AquaThought's own human-dolphin interaction research. Attendees can examine how neuroscience is converging with visual and musical art, consciousness research, and virtual reality.

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Human/Dolphin Virtual Reality World Concept

The Human/Dolphin Virtual Reality World Concept is a vision of a world – a computer-generated simulation of an environment – where humans can experience a visual and auditory perceptive space with a dolphin.

This project is a cooperative enterprise involving a group of scientific and artistic researchers who are applying the cutting edge of technology to a common goal: advancing human intelligence through communication with other advanced intelligence. It required development of interfaces that are currently used in a medical rehabilitation center to enable severely disabled individuals to interact in artificial environments. An extension of this research is the design of environmental systems that support experiential interaction with information systems to monitor and promote good health. Collaborators on this project have been featured in popular publications such as MacWorld and Wired and covered by popular media through presentations on Beyond 2000.

For SIGGRAPH 94, the Human Performance Institute has extended these interactive technologies into areas of interspecies communication. A goal of the Human/Dolphin Virtual Reality World Concept is to make visible an experience that is invisible to the general public: "being dolphined." Real-life sensorial communication with a dolphin creates understanding of human multi-sensory capabilities.

The virtual environment is an underwater, multi-dimensional, experiential environment designed for one participant at a time. Attendees can spend three to five minutes in the Human/Dolphin Environment (HDE), where they experience the technical advancement of the research and the phenomenon of communication with another intelligent species. The visual and auditory aspects of this perceptive space will be controlled by the user through neurological data transmitted through electrodes on the user's body to a computer and then represented as a simulation on a screen in front of the user in an underwater virtual space.

Each hour, 10 attendees participate by entering a room-type space with electrodes placed on their bodies. They are comfortably seated in a vibrasonic chair in front of a large screen with four speakers around them. Hardware components for the technical execution of the simulated environment are incorporated into the room in a semicircle-like panel behind the user. This panel includes an IBM 486, Mac Quadra 660AV, the BioMuse, IBVA with MIDI interface, and control devices, monitors, and adjustable light.

Interactive and virtual technologies represent a fundamentally new way for people and computers to interact. As the capacity of computers to receive, process, and transmit massive amounts of information continually increases, technologies gain new powers to translate natural human actions of communication, such as thinking, speaking, and moving, into computer commands and information displays. Practical extensions of this symbiotic process linking human and computer intelligence are only just beginning to be perceived by the forerunners of art and technology, but with the technological systems currently under development, perception is the key ingredient for simulation.

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Waxweb

Waxweb, based on David Blair's electronic feature "Wax or the discovery of television among the bees" (85:00, 1991), is a large constructive hypertext that has been converted to MOO-space (Object-Oriented MUDs) as part of the Hypertext Hotel. Tom Myer modified MOO code to make the Hypertext Hotel a suitable environment for full, simple hypertext reading and writing plus the ability to view and add stills, audio, and video by a connection to NCSA Mosaic. These functionalities are embedded in a text-based virtual reality that gives multiple users the capacity for synchronous intercommunication.

About 10 months ago, "Wax or the discovery of television among the bees" was sent out over the MBONE (multimedia backbone) of the Internet by Vince Bilotta, which prompted John Markoff of the New York Times to write a story titled "Cult Film is a First over the Internet," casting the event as a milestone on the way to 500 channels. Unfortunately, at the time, there were really only about 450 sites able to see the "film," a fact that was a bit strange to point out to the people who wrote asking how they could see "Wax on the Internet." The article also failed to mention that this was not a broadcast, but a multi-cast, meaning anyone who could receive could also send audio or video (or text, of course), so that an individual's reception screen could be filled with little boxes of talkie.

Waxweb is an attempt, within some necessary limits, to re-multicast "Wax" at a bandwidth more appropriate to the current Internet. All users of Waxweb will have access to its densest layer, the constructive hypertext. Users able to run Mosaic will have access to additional levels of functionality, depending on the width of their connection to the net (or their patience). Two thousand still pictures, an audio version of "WAX", and the complete audio/video content of the film will be made available as hypermedia attachments to the main text, creating the equivalent of an on-line multimedia CD-ROM that multiple users can simultaneously read from and add material to.

Waxweb is a practical and aesthetic experiment in multiple-media, integrated narrative. It is a laboratory for a planned electronic feature investigating how artists can produce multiple-media, integrated narratives out of a single dataset using hybrid tools to affordably create a multitude of hybrid forms to form a single narrative.

Most text tools have collapsed into the integrated text amplifier – the computer – allowing us to do anything we want with words, in any order we want, on the way to composition. At the same time, we have gained the ability to project these functionalities across any distance, allowing us to not only write or read, but to do many hybrid things that are neither exactly one nor the other. This will not only increase the number of hybrid media production forms, but the number of hybrid, multiplexed works that are unitary yet take multiple forms: where a single, variegated chunk of proto-narrative, proto-image, proto-anything data can, and often will, take many different forms, each of which will have the aesthetic tension of being morphologically similar, though in different media.

Audience participation

On-site users are able to read from and write to the film – in essence, to reprocess it. SIGGRAPH 94 participants are offered the following answers to the question, "What do I do?": Do what you will, be it false back-story, or simple linkages between places with interstice boxes that explain ordinary obsessions. You can make a random structure of odd small stories, or a counter-structure of formal mechanism or anti-story. You can write an essay or anti-essay or faux-essay in linked little boxes. Or you can create new paths that intersect the story in horrible ways. You can learn the MOO software. You can talk to other people.

This input will be edited and published as a hypertext and CD-ROM edited by Michael Joyce and Larry McCaffery. Participants will be warned of potential republication and will be asked only to read if they do not agree to duplication. It will not be possible to pay published participants.

An introductory document to the hypertext features of the MOO is available by anonymous ftp from count.cs.brown.edu, in /pub/hypertext/docs.txt.

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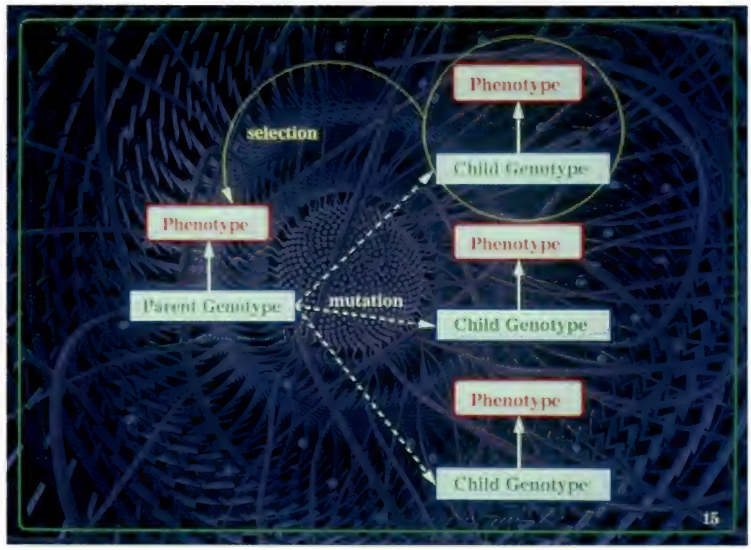

Turbulence: An Interactive Installation Exploring Artificial Life

"Who dwells in a realm,
magical and barren,
Without a before, and after,
or a when...
To be forever;
but never to have been."
From "The Enigmas"
Jorge Luis Borges

"By the middle of this century, mankind had acquired the power to extinguish life on Earth. By the middle of the next century, he will be able to create it. Of the two it is difficult to say which places the greater burden of responsibility on our shoulders."
From "Artificial Life"
Chris Langton

Turbulence is a menagerie of computer-synthesised forms based on the new science and philosophies of artificial life – the formation of life-like forms and processes from materials other than those found in nature. The work looks at poetic relationships between logic and purpose, and their relation to fundamental arguments about vitalism, destiny, and human consciousness.

Using "genetic" algorithms to produce artificial life forms whose shape, form, and behaviour represent "algorithmic ecosystems," Turbulence develops and examines abstractions of life-like processes. Such processes are manufactured from a deterministic set of instructions applied millions of times by the digital computer. These synthetics are contextualised within the categorisation and classification of life by biological science. In many ways, the work is a type of futuristic natural history museum – a document of a type of life that exists only within the abstract space that becomes visible with the synergetic combination of mind and machine. Everything develops in a space somewhere between composition and adventure, between chance and destiny, between intent and invention.

The installation operates within an enclosed space and is decorated to (in some ways) resemble a natural history museum from the previous century. There are two main components inside the space: an interactive multi media program and a projected animation from a video laserdisc controlled via a small touch-screen interface.

Viewers enter an enclosed, darkened space. Along the walls are specimen jars that contain preserved examples of organic biological life: flowers, insects, organs, photographs of people, the components of living organisms. Many of these objects relate in some way to the video sequences on the disc. The jars are dimly illuminated internally. The overall impression created by the space is that of a strange natural history museum.

Farther along the entrance passage is a screen which runs the informational multimedia component of the work. Here, users can interactively evolve their own simple 3D organisms and learn about the processes and concepts of artificial life and its relation to the work on the disc. Sections also contain associated explanatory text, giving background information on the organisms, facts about reproduction, possible

observations, and reactions. At this point, the user is introduced to the "logical" components of the work. What lies beyond is a poetic interpretation of these ideas.

Turning a corner, the viewer enters a dark space with a small plinth facing a projection screen. The plinth contains a touch screen, which controls the display of high-quality video segments from a laserdisc. Words and images float and spiral on the touch screen. Touching a word usually displays a section of animation on the projection screen. Collections of animated segments are grouped both thematically and by imaginary "species," linked by their genetic relatives. It is important to remember that all the organisms are fictions, evolved by a software program during production of the project.

There is no start or end to the work, but as the user progresses with the interaction the software "learns" which areas the user is exploring and responds with inter-related options (i.e. the work tries to adapt to the personality and whims of the user). The nature of the interactivity allows different users to begin and end at any point within the work and quickly establish where they are within the structure.

Apart from its conceptual and thematic ideas, the presentation style is highly theatrical in nature. As has often occurred throughout the history of science, there is an apparent conflict between what is scientifically defined and what is undefinable within the consciousness of the individual. Science keeps coming up with ways to disprove our beliefs. The further down this spiral we travel, the less "human" we become.

The notion that a type of "life" can be synthesised by a machine and the potential of this current research has many important repercussions for our own evolution and our understanding of what life is. Despite all the "how," paradoxically, science has got no closer to a "why." These are the key issues that are examined here. Questions are not looked at from the purely mechanical or scientific view – the underlying context is the conflict between the logical view of life as the summation of discrete processes and the actuality of human consciousness.

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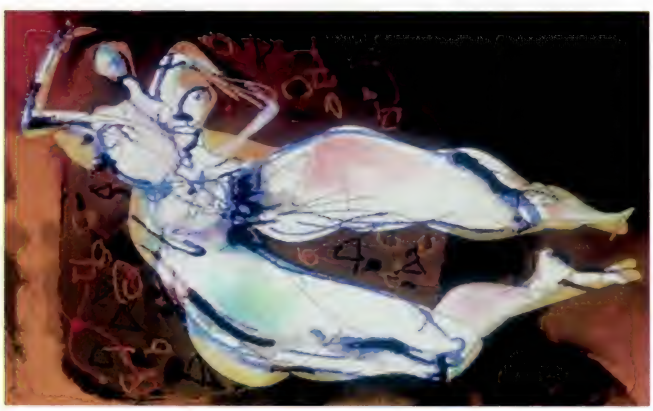
For further technical information refer to:
McCormack, J.P., Interactive Evolution of L-System Grammars for Computer Graphics Modelling, in Complex Systems: from Biology to Computation, David Green and Terry Bossomaier, eds., ISO Press, Amsterdam 1993.



RENGA (Linked Images)

The title RENGA (Linked Images) is a wordplay on RENGA (Linked Verse), a Japanese traditional poetical genre. The first ideogram, REN, means to link or associate. The second ideogram, GA, means poem. A different ideogram, also pronounced GA, means image. Substitution of GA (image) for GA (poem) creates a new word: RENGA (Linked Images).

The introduction to "Kokinshu (a collection of ancient Japanese poetry)" compiled in the early 10th century contains the following passage: "Waka (Japanese poetry) moves Heaven and Earth without the use of physical force." In modern times, literature is believed to develop in a metaphorical space outside of the physical space we inhabit. We all know that TV dramas are fiction and that fiction never interferes with reality. But in earlier times, metaphorical space and physical space were connected. Poetry was thought to mitigate a prevailing epidemic and occasionally served as a tool to lead a national project to success. Ancient people had a sense of awe and were moved by the mysterious power of words, which could affect an object without exerting any physical force.

This richness of words is lacking in modern society. The expression "could effect an object without exerting any physical force" could be applied to the electronic media around us. Today, it is digital technology that fuses physical and metaphorical space. Information network systems melt the long-frozen richness of the metaphorical space and restore its abundance to us. They also show us that an archetype of our new experiences in electronic media can be found in the expression of ancient people.

The ancient people's most important suggestion might be the achievement of creative correspondence between one another. It is commonly believed that painting or composing poetry is an extremely solitary creative process. This is often true. But creation is sometimes a collective process, occurring within a "network of influences." Such influences can be anything from inspiring hints, to subconscious stylistic appropriation, to responding to an existing theme. Most artwork is generally more the result of a dialogue than its creator consciously recognizes.

RENGA (Linked Images) was triggered by a workshop on computer painting held in the winter of 1991. A work by Rieko Nakamura was loaded into the painting system in front of me. Although the painting was digital data that could be reproduced an infinite number of times, I was reluctant to modify another person's completed work. But I dared to add some touches to it, and then "undid" the change. I repeated this process several times. This casual operation gave me a pleasant surprise. After awhile, I forgot about undoing it and further modified the work in my style until it became a sort of hybrid of my style with remnants of Nakamura's.

In April of 1992, I suggested to Nakamura a creative method to make this scintillating play an organized activity. Taking an image received in electronic mail, an artist would import it into a painting system, deform it, recontextualize it within another image, even print it out and physically draw on it, to rescan it. By repeating this process, a series of works just like a picture scroll would be created.

Each resulting image is something which is at once unquestionably one's own artwork, while at the same time something which could never arise from one's own artistic monologue. So far, we have tried two sessions of RENGA. We learned how to appropriate images from the other artist's work, as well as to be appropriated. Just as learning another language leads to the discovery of a new self image, each of us has discovered another self through RENGA.

Perhaps the invention of RENGA (poetry) was a formalization of the natural interaction between oneself and the community, before the establishment of the contemporary sense of self as a tool. Digital media and network communications have the power to bring the fixed boundary of personality back to its innocent state. Cyberspace is often mentioned in terms of the gradual loss of our senses of time and distance. It may cause a loss of identity, but it could also serve as an opportunity to encounter our more natural and familiar self-image. RENGA (Linked Images), is an experiment in the acceleration of these possibilities within digital technology.

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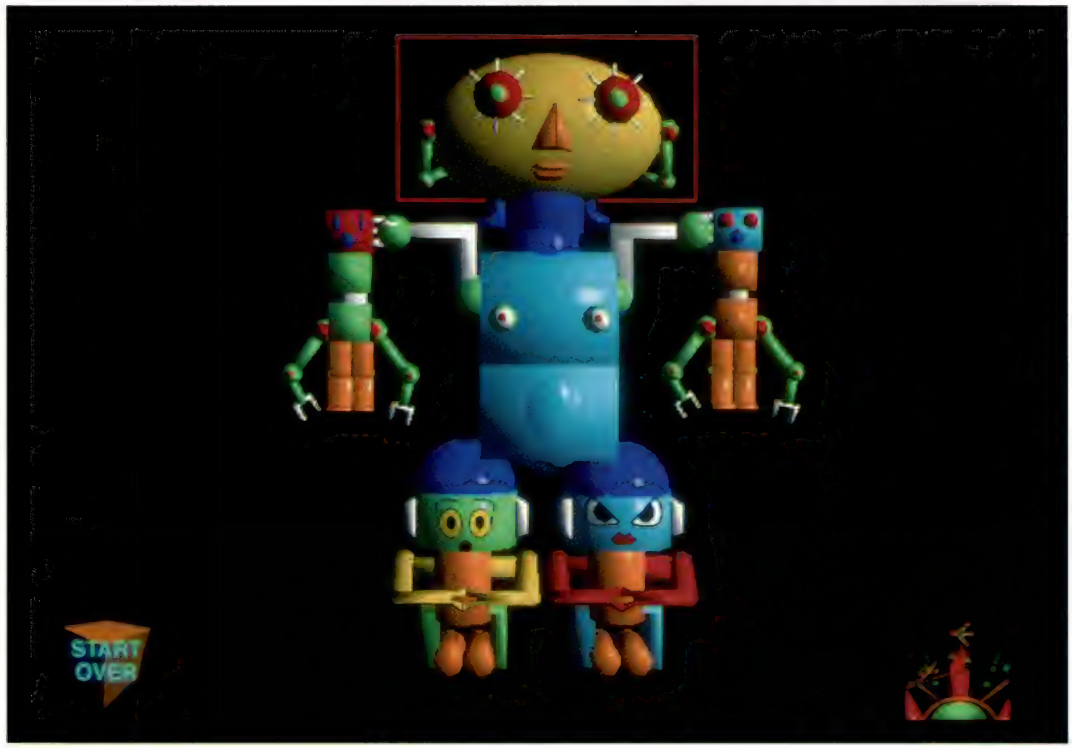

IDEA-ON>!:
Database of Experience

Idea-ON>! is an electronic database of ideas and experiences, each one contained in a "place" in one of four "new realities," which the user will discover through exploration. Many visual languages are combined, as the database borrows aspects of video games, landscape painting, interactive multimedia, and motion pictures to form a "new language." Idea-ON>! also uses a personal language of forms and symbols, which manifest in the interface, the landscapes, and the beings that inhabit it. Through immersion and exploration, many different viewpoints become apparent, building up an experience that reflects the user's expanding relationship with the work.

Body language, spoken word, written language, and symbolic systems fuse with our environment and media to create a range of spatial and temporal communication systems. Each of these "landscapes" has evolved its own codes with which it can be experienced and interpreted. However, new constructs of space are being created through the continual juxtaposition of a varying range of information in a hypermedia space. These spaces are constructed from "media" to create an involving, personal journey in a world that appears to live and breathe, and react to the user's presence. Much like parts of today's Internet, Idea-ON>! is a collection of thoughts and things, floating above and around the big information super highway. It is a space for exploration and discovery.

Idea-ON>! rejects traditional flat-user interface design and offers the user many different forms of engagement. Setting up the piece to be simply an "experience" with no need to promote a product, provide information, or communicate any consistent message has allowed the opportunity for freeform experimentation with the standard click = response routine. Things may happen without user interaction, the user may have to explore in more detail to find certain pathways, or responses given by the objects and beings will vary, often following a surreal kind of logic. It is interactivity for interactivity's sake, experimentation with what is possible.

On-screen entities and agents allow the user to relate to another "intelligence", rather than to a computing machine, similar to the way that people relate to actors in a film. In this same way, actions can be performed by the on-screen entities in response to the user's choices and responses to them. Also, because they are animated and not real people, they can perform any role required of

them via special effects and so on. The world in which they live follows it's own rules. Entities and agents draw the user in because of their visual interest, giving the user a reason to keep exploring the interactive worlds. They can also symbolise ideas in an interactive, "physical" form, much like living, moving sculpture. For example, the NetBot is a large robot made of six smaller robots that act as vessels for various types of information. She is like a physical manifestation of a simple hierarchical computer desktop system, similar to a Russian doll, but shrinking in six directions.

Each of Idea-ON>!'s four "new realities" prototypes different aesthetic, structural, and communication-based approaches to virtual space:

Techno Garden
An electronically generated world that grows and exists like a coral reef. As time passes, more buttons sprout and grow from the organic landscape, backed by an atmosphere of organic sounds and strange computer noises. The garden is mapped out like a series of islands surrounded by a body of water. The structure seems chaotic, with many things linked back and forth in various directions.

Cybaroque World
A palace of flesh and body expansion, muscle building and health diets, gold and luxury, money and power, sex and material wealth. It uses aesthetic seduction to entice interaction with it, much like contemporary advertising, with samples of classical music and seductive voices throughout. Beings in this world are made of gold and luscious flesh, patterned with intricate swirls and decorative motifs. This world is very structured, with marble pathways leading you through the space.

Communication Overload Data Sphere
Television, movies, soaps, magazines, satellite communications, street signs, samples from the mass media build up in layers of chaos to fill the screen. The sound track is a mix of electronic beeps and bops, electronically processed voices and samples. A communication sphere is entered through a gate, after which you rotate through eight pathways leading outwards in all directions. This is a world that is constantly expanding with the eight paths of information branching off into further subsets of each of the eight categories of information.

Celebration of the Iconbody
In this place, all things are communicated with gesture and symbol. Interaction occurs through fragments of a dance, which moves through a series of iconbody positions – human body positions that symbolically represent an emotion or human state of being. Varying beats play with chanting and electronic rhythm loops. The Celebration of the Iconbody is mapped out like a spiritual diagram of a deity, each location appearing as a colored energy sphere.

Visiting the Idea-ON>! installation can be likened to visiting a sacred site where spirits and myths reside. It is entered through a gateway, symbolising the transition to the "other reality." The information space inside the computer becomes a dreaming or meditational space, a manifestation of the subconscious where the objective contents of thoughts are stored for others to explore and experience. Similar to the way pre-linguistic societies shared a body of myths and legends that made up their perception of the universe, a world like Idea-ON>! jumbles together many things towards a prototype of a dreamlike, surreal, communal cyberspace in which people dream, create, imagine, and play with thought and form.

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Voice Dancers

In many people's minds, head-mounted displays are synonymous with virtual reality. However, the technology that has been demonstrated does not conform to their mental image of it. They imagine themselves traipsing through the virtual world as naturally as they walk around the real one. Unfortunately, such a wireless walk-around capability has not been demonstrated. Instead, participants typically must point their fingers in the direction that they want their eyes to fly in the simulated world. The ubiquity of this awkward expedient obscures the possibility that exploration by walking is the one function that the encumbering approach to virtual reality might do better than the unencumbering techniques.

The premise of this exhibit is that wireless operation and freedom of movement are more than technical issues. They will change the character and quality of possible interactions in virtual worlds.

Voice Dancers defines a long virtual path for participants to follow. The virtual landscape that surrounds it is inhabited by shy graphic creatures that can be enticed into playful interactions. Their behavior is designed to take advantage of the objects in the virtual world as they interact with the participants. Their purpose is to evoke interesting movements by participants and ultimately to lead them to the end of the path. At the entrance to the data path, a large projection screen shows the current participant walking through the virtual world.

For the last decade, I have been one of the most visible critics of the goggle-and-glove version of virtual reality. That is partly because I prefer the unencumbering approach that VIDEOPLACE offers. I also believe that the technical community has ignored issues that are important to me in their implementations. For years, I have indicated that I thought I knew how to address these issues. This year, I have sketched out the approach I have had in mind. As one might expect, it draws heavily on the real-time video perception that I have been working on for the last 25 years and have been demonstrating at SIGGRAPH since 1985.

The point-and-fly method of moving in a virtual world is not a natural one. The ubiquity of this awkward expedient does not make it intuitive. It must be carefully explained, and it takes some time to learn because it confuses the role of the hand, which is simultaneously a navigation tool and a grasping instrument. Even when a limited range of walking is permitted, the cable that always connects the participant's head to the computer inhibits movement, compromises the sense of immersion, and distances the participant from the experience.

In Voice Dancers, the participant wears a head-mounted display based on my own design concept. Because no wires connect the participant's head to the computer, the participant is able to move more freely than with any system shown so far. Since this project would be worthy of a million-dollar budget, this zero-budget implementation necessarily imposes its own constraints. It focuses on walking at the expense of grasping. Participants' movements are constrained to walking along the path. They must move slowly, because high-speed body movement is faster than any existing tracking technique and certainly faster than this one.

Wireless operation allows people to understand the virtual world instantly. The freedom to explore the virtual world on foot is one advantage that the encumbering approach to virtual reality might have over unencumbering techniques such as my VIDEOPLACE technology. Therefore, I feel that it is important to take this step and let the members of the virtual reality community decide if such movement is significant.

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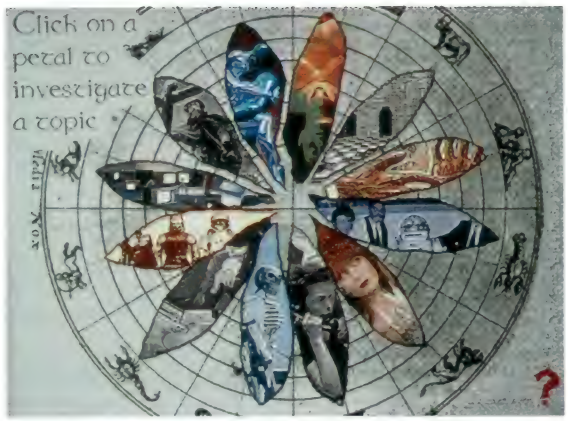
She Loves It, She Loves It Not: Women and Technology



She Loves It, She Loves It Not is an interactive CD-ROM created by Christine Tamblyn in collaboration with Marjorie Franklin and Paul Tompkins. It contains text, sound, movie clips, and images about women's use of technology in the past, present, and future. Over the last two decades, feminists have identified men's monopoly of technology as an important source of male power and argued that women's exclusion from access to technological prowess is a crucial element in their dependence on men. She Loves It, She Loves It Not addresses this issue from several different angles.

The CD-ROM, which was programmed using Macromedia Director, requires a high-end Macintosh computer, a color video monitor, and stereo speakers. The initial interface is a graphic image of a daisy. Each of the petals of the daisy represents a loop of screens with a particular theme: Memory, Control, Power, Communication, Violence, Homunculus, Labyrinth, Interactivity, The Other, Representation, and Ideology. When a viewer clicks on a petal, the loop begins.

Each screen is composed of a headline, a block of text, a static image, and several "buttons" that open up to various elements. The images are derived from various found sources, including comic books, a catalog of robots, magazine advertisements, and art works. The text concisely analyzes the topic from the perspectives of cultural studies, sociology, and film history. A continuously looping sound is also associated with each screen.

Special animated buttons allow viewers to read handwritten letters, watch Quicktime movie clips (digitized at 5.5 frames per second for a defamiliarizing effect), or see "footnote" text with more detailed information about a specific topic. The Quicktime movie clips range from commercials depicting women's enslavement by and subversive use of domestic appliances to industrial film excerpts revealing pervasive gender stereotyping in the workplace and science-fiction film clips that imagine the invasion of women's bodies by futuristic machines. The text contains 84 screens and takes about an hour to view once in its entirety (in one possible configuration).

The visual aesthetic of the piece has a handmade collaged look. Because it deliberately avoids the slick sterility of much computer art, it serves as a prototype for exploring some of the new potentials of the interactive CD-ROM format. Both the form and the content of the work attempt to demonstrate how women might use and have used technology differently and how technology might adapt to female learning proclivities and female culture. An integral part of the project is the design of computer interfaces that are more user friendly for women. Because computers have evolved as tools built by men for men to be used in warfare, the current interfaces tend to have a violent, aggressive character. They are hierarchical, mirroring the militaristic male pyramid with its rigid chain of command.

Current interfaces also have a predominantly visual bias, privileging the male gaze and male strategies for control through surveillance of territory. Interfaces designed to be operated by women ought to be multisensory, personal, affective, and dynamic. For She Loves It, She Loves It Not, interface development involved creation of a female persona in cyberspace who serves as a guide to the system. The navigation buttons on each screen appear inside an image of this persona, and her voice gives instructions about how to proceed.

By envisioning a more productive relationship between women and technology, this project benefits women who are using new technologies in a variety of academic fields and artistic endeavors. It is designed for exhibit as an art installation and, because it provides positive alternatives to the negative stereotypes regarding women and technology often inculcated in early educational experiences, as an instructional resource for women students. Just as feminist theorists have stressed the importance of women having access to the position of speaking subjects and "having a voice" in our culture, it is similarly important for women to have role models for computer literacy as computers become an essential communications tool.

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Softworld 2.1: The Imperial Message

The Imperial Message is an interactive virtual reality experience – a new medium somewhere between architecture, film, and game.

Softworld 2.1 is an "anti-war game" inspired by the Kafka parable, "An Imperial Message", which deals with the vast distance between the Emperor and the Individual. The program attempts to extend this sense of scale to present inherent conflicts between the individual and the state and between the unspoken, secret "Law" and its corrupted representation. The viewer or player navigates through the softworld, finally arriving at the "Source of the Law." As the player makes choices, they reveal the player's "character," which in turn determines how the experience develops. Individual play times are approximately ten minutes; at the end of that period, the player has reached one of several possible conclusions.

The player's interaction with The Imperial Message raises questions about the relationship of interactive media to surveillance, authority, and control. For example: What structures of power will apply in digital space? What new social systems may emerge?

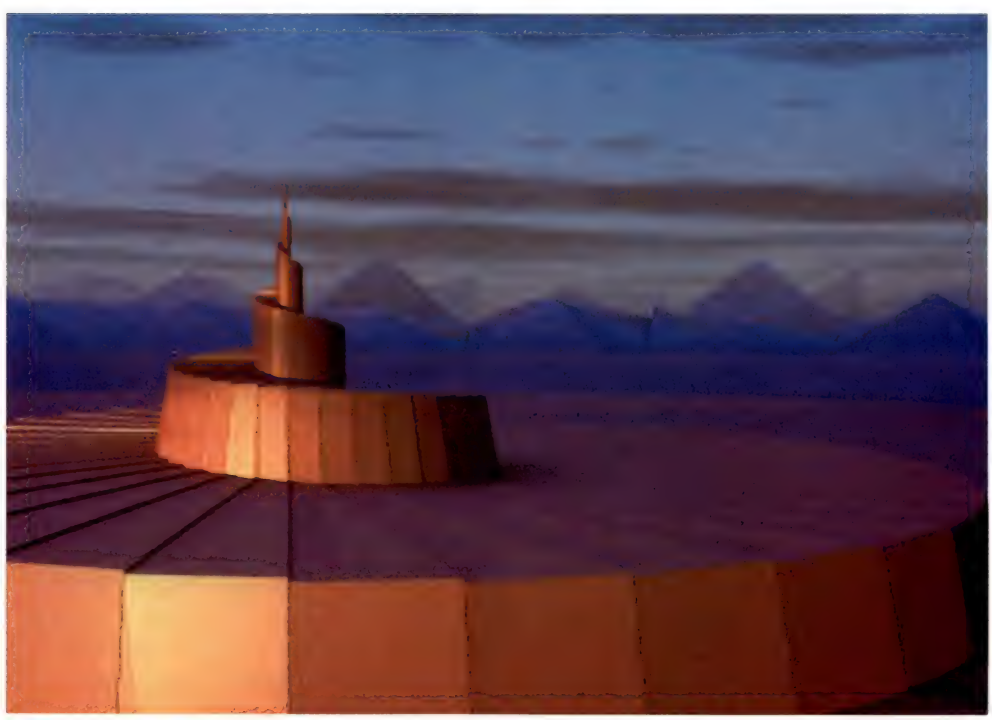
Technically, the software integrates real-time, computer-generated simulation and role-playing-game strategies, incorporating systems originally developed for military simulations. The program also makes some use of artificial intelligence programs using active agents with some degree of "free will." The musical score is by avant garde composer, Alvin Lucier.

Artist-in-residency award at the Wexner Center for the Arts

Softworld 2.1: The Imperial Message was designed and developed in residence at the Wexner Center for the Arts, an internationally renowned multi-disciplinary contemporary arts center located at The Ohio State University in Columbus, Ohio. The purpose of the Wexner Center's artist-in-residency program is to encourage and support vanguard artistic initiatives.

Beyond the production of The Imperial Message, the residency award has provided a forum for discussion regarding interactivity and aesthetics. Throughout the year, Softworlds' members have participated in workshops, symposia, and lectures utilizing the resources of The Ohio State University and in particular its Advanced Computer Center for the Arts and Design (ACCAD).

This project draws on the resources of several generous corporate sponsors, among them Kubota Pacific Corporation, which manufactures the high-end, real-time geometry and texture processor. The original model, animated sequences, and textures are produced by BlueSky



Productions' proprietary rendering system. Real-time simulation software is by Sense8 Corporation. Elias Associates produced and "designed" the audio components of the piece. IBM donated the PC that is used to process sound, along with Crystal River Engineering's Beachtron Sound Board. Virtual Research donated the head-mounted display, and Polhemus, Inc. donated the tracking system.

Softworlds, Inc.
Softworlds, Inc., founded in March, 1992, is an artist collaborative formed to create and publish interactive and digital art. Its members include Janine Cirincione, Curator and Partner/Director of the Jack Tilton Gallery, New York; Brian D'Amato, novelist/artist/critic; and Michael Ferraro, Vice President and System Architect, BlueSky Productions, Ossining, New York.

The studio's main objective is to create interactive literary works and digital world designs that integrate developing technology with aesthetic concepts. Ideally, these world designs or confrontive architectures will become important structures through which people will experience the expanding digital environment. In researching the language of interactivity and helping it grow as a viable artistic medium, Softworlds hopes to redefine the role of the subject through new forms of experience.

Softworlds also believes it is necessary to make its interactive art works accessible to the public. To this end, the studio will employ digital information networks to bring art to people beyond the reach of the traditional art world via consumer technologies. The studio hopes to add cultural value to these networked systems by providing them with provocative and engaging interactive experiences.

The studio focuses on intellectual content and not on the novelty of new technologies. Because the content of Softworlds' work is independent of its technological delivery systems, it can be realized through several media, including CD-ROM and virtual reality systems.

Softworlds' first interactive digital world design was Softworld 1.2: Sacrifice, presented at the New Museum of Contemporary Art, New York, as part of The Final Frontier exhibition. The nature of this interaction is derived from both pre-Columbian Mayan themes and the format of Parcheesi and chess-based board games. The objective of Sacrifice is to "kill" yourself as often and as spectacularly as possible. Depending on intuition and nerve, the player is reincarnated in progressively more advanced landscapes, eventually reaching the "Heart of the Sky."

The Edge
Softworld 2.1: The Imperial Message is an important paradigm for interactive art works. What sets this project apart from most other virtual reality experiences is the attention to aesthetics and content. The Imperial Message brings together the resources of many singular talents from a variety of disciplines such as fine art, music, computer science, theatre, film, architecture, and philosophy. From design to production, The Imperial Message seeks to push the boundaries of what is currently available in a real-time virtual reality experience. By integrating BlueSky Productions' high-end proprietary rendering software with Sense8's real-time system running on Kubota Pacific Denali workstations, Softworlds has developed a new standard for visual quality and interactive responsiveness.

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Proyecto Xochicalco: A Networked Virtual Environments System Featuring an Ancient Aztec/Mayan Ball Game Played on the Replicated Virtual Site of Xochicalco, Mexico

Proyecto Xochicalco (shó-shee-cal-co) is a sophisticated, networked virtual environments game system that uses the power of this new medium to simultaneously address two application areas: entertainment and education. It enables multiple, simultaneous, networked users to inhabit the accurately reconstructed environment of Xochicalco, the Aztec/Mayan archeological site. Participants play an ancient Aztec/Mayan ball game and interact with a human guide in the virtual environment. While the Aztec/Mayan archeological and artistic content are of particular interest to artists and educators, the entertainment aspects of the game and its leading-edge technology appeal to a wide audience. By enabling several participants to simultaneously explore a rich historical site while taking part in an authentic game from an ancient culture, Proyecto Xochicalco strives to achieve a unique synergy of entertainment and education.

System Configuration

The system utilizes three high-end image generators in three separate locations. One image generator supports two simultaneous users (one visitor and one guide), while the others support one user (visitor) each. Each user is equipped with a stereoscopic head-mounted-display (HMD) with a magnetic tracking sensor and a waist band with another sensor for tracking the position and orientation of the torso. The waist band also includes a force feedback device, which actuates a pulse when a player comes into contact with virtual objects. The guide wears a larger complement of tracking sensors for more complete body position tracking. Each user's headgear also incorporates a microphone and headphones, which facilitate voice communication and synthesized sounds in the virtual environment. Sounds are spatially localized to accurately simulate the distance and direction, and provide important cues for game play and communication.

Each participant stands in a circular area surrounded by a protective rail. Leaning in any direction within this area causes the participant's position in the virtual environment to travel in the corresponding direction. Centering

oneself in the area stops the motion. The game also uses the direction and orientation of the participant's torso to determine the reaction of the ball when it comes into contact with a player.

While all the participants simultaneously occupy the same virtual environment, they are, in fact, in physically separate real-world locations. One participant is at a game station at The Edge, the guide and another visitor are at two other stations at SIGGRAPH 94, and a third participant is at a station in the Boston Computer Museum. These stations are networked through the Distributed Interactive Simulation (DIS) protocol used by the Department of Defense.

Participation Scenario

Operation of the system begins with an exhibit staff person putting on the guide's headgear and tracking sensors. Nearby, another exhibit staff person helps a participant put on another set of equipment. Another player prepares at another game station, and another exhibit staffer gears up in Boston. After they don the equipment, all four participants are situated near each other in the virtual environment so that the guide can instruct all the players at once. Then two of the visitors are allowed to play the game in the Xochicalco ball court. The guide directs the third participant toward other interesting features of the archeological site. This participant is free to wander around and explore the environment or to watch the game from any vantage point. At any time, any participant can ask the guide for help or information.

After 2.5 minutes of game play, one of the players leaves the virtual environment and removes the HMD and waist band. In the virtual environment, the guide then directs the third participant to the ball court to play the game. The idle HMD and waist band are then passed on to a new participant, who listens as the guide explains the play of the game and points out areas of interest at the archeological site. Game play and site exploration continue in this round-robin fashion. Each participant has a total of about 7.5 minutes in the virtual environment (about 2.5 minutes to explore the site independently and about five minutes to play the ball game twice. Eight participants per hour go through each visitor station for a total of 24 per hour for the entire networked system.

Xo at The Edge

Proyecto Xochicalco is an ambitious effort to integrate high-end communication technologies with high-end, real-time graphics and immersive techniques. The system offers shared experiences in a virtual environment tied together by a high-bandwidth, geographically distributed network. By incorporating spatialized audio, immersive real-time graphics and force feedback, the system provides a multi-sensory interface richer than anything possible with a single-display mode in isolation.

Participants learn about an ancient culture by taking part in a game that had an important ritual and political role in its society. By allowing participants to play a millennia-old game in an environment shared with others physically distant in today's world, the system strives to transcend geographical and temporal boundaries and cross The Edge.

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uniVRsum
VRASP: The Virtual Reality Alliance of Students and Professionals

uniVRsum evolved from a VRASP chat on 25 January 1994, when the contributors considered resurrecting and improving several of their existing demo/prototype projects, including the "Best of All Possible Worlds Contest," the "Literary Gallery" (a demo shown at Meckler in 1993), and "PIX-Interactive" (an electronic version of their internationally distributed magazine). Individually, these creative exercises honed members' programming and design skills. Combined, the projects represent VRASP's contribution to virtual reality in the past year.

Interestingly, the programming challenge of uniting the projects revealed a few of the virtual reality industry's shortcomings. The project team longed for a uniform data format and a standard protocol. Communication issues and interfaces between people and machines, between applications, and from toolkit to toolkit were addressed. Solutions would be shared with the entire industry and, ideally, would empower both the user and designer of technology. Because VRASP is non-partisan, it not only provides a neutral, non-commercial ground for artistic creativity, but it also believes that uniVRsum's success could provide an ecumenical influence on the shape of today's DOS-based VR technology.

Since a major impediment to mass appeal and understanding of VR arises from lack of accessibility, uniVRsum has three primary goals:

• To provide a focused and structured hands-on learning experience for VRASPians.

• To devise as entertaining and comprehensive a showcase of VR products in one experience as possible.

• To build industry standards that will allow disparate toolkits to interoperate.

Initially, the device to accomplish these goals is a prototype buffer application program interface that provides smooth transitions between worlds created with different VR toolkits. By resolving such obstacles as communications protocols, VRASP hopes to facilitate human interaction in VR and encourage world builders to allocate more resources and energy to improved design and content.

uniVRsum mirrors the complexity and challenges of real life. Participants with imagination and intuition are given an electronic and peripheral framework in which to exploit the exhibit to its fullest on their own. For those requiring more guidance, a panic button summons a travel agent. Unique or repetitive experiences incorporating multi-sensory techniques are used to train the participant, while other, purely artistic elements exist only for their appreciation. Portals to worlds span the range of passive to active participation. One of uniVRsum's design emphases is fostering immersion; an informal survey quantifies the public's perceptions of the weakest and strongest elements of experience processing.

One could argue that the obstacle of the inflexible interface won't be solved until there is computerless computing – freedom from the restraints of monitor, keyboard, and workstation. But within the limitations of low-end PC technology VRASP weights the quality of the experience toward the explorer rather than the couch potato. Learning depends heavily on interactivity and instinct, as well as on constant awareness of the few senses that our platform supports.

Technical Details

The following toolkits are used as subjects or renderers in uniVRsum: Lepton, REND386 (and subsequent versions), VirtusVR, VistaPro, VREAM, VR Studio, VRT, and WorldToolKit. AutoDesk's AnimatorPro and 3D Studio and Paradox also have roles in uniVRsum.

A baseline virtual world launches other worlds or animations. The broadest possible spectrum of visualization possibilities is incorporated, to emphasize the importance of freedom of choice in toolkit selection. Programming goals for the project include: creation and description of a hierarchy that defines flexibility, i.e. compatibility of worlds; optimization of common denominators of data transfer in and between worlds; promotion of formats and protocols that give greater accessibility but do not hinder vendors' current software development; and customized "hooks" to upgrade toolkits whether they use libraries or scripting languages.

Networked computer systems support uniVRsum's long-term goal: a shared environment for multiple participants. An introduction to the concepts of distributed interactive simulation will prepare designers and users for the ultimate expression of experience processing and data visualization. However, the majority of experiences will be single-user.

As virtual reality is the melting pot of many supporting technologies and can be applied to as many diverse applications, uniVRsum hopes to unify the most inspiring and informative elements in a representative whole. As a project and as an experience, uniVRsum promotes the growth of virtual reality technology and content by fostering accessibility for everyone.

The virtual world traveler wants flexibility, freedom of choice, easy transition between worlds, and manipulation and transfer of objects. Surely, this will all come to pass. Hopefully, uniVRsum will hasten the process. As it evolves, uniVRsum will serve as a clearing house of information, ideas, and worlds. In effect, it will be a multimedia expression of what the Virtual Reality Alliance of Students and Professionals strives to accomplish as an organization.

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A Virtual Shopping Mall: Coming soon to the crossroads of the Infobahn

Cyberspace is often imagined as an abstract data representation or an adventure in a computer simulation representing the physical world. The original intention of this project was to represent cyberspace as something more than reiteration of familiar space in a digital form. Due to the nature of the intended use, and the environment's target market (human factors specialists, middle-class shoppers, and a jury of architects), the developer decided that creation of a workable environment required the use of existing notions of time and space, which were later broken down.

"Why shopping?" one might ask. This project is an investigation of how the practice of architecture might be able to contribute to the representation of cyberspace. Shopping is a provocative vehicle. It allows exploration of how middle-class shoppers might interact with virtual reality technology from an architect's viewpoint. The combination of an important cultural pastime with advanced technology reveals how the technology might change our ideas of shopping and spatial perception.

Shopping malls and their chain stores have replaced older neighborhood stores and ways of shopping. Malls have become places of entertainment and socialization as centers of consumtion. It is hard to know if a theme park is a mall or if a mall is a theme park. Home shopping networks and catalog shopping are becoming more popular as busy people find it easier to shop at home at three in the morning than to worry about the hassle of getting to the regional mall.

A virtual shopping mall will enable shoppers to control the direction of their experience instead of being restricted to choosing the current item offered on television. Products and selections will have an added dimension, since they are stereo. And, in time, technology will allow touch and smell to complement the shopping experience. Shoppers will have a better idea of what they are buying. Another important development will be the ability to shop in virtual malls around the world with others of similar likes and desires. Theoretically, shoppers could select the types of stores they wish to have in their own personal mall or they could elect to visit community malls.

The current version of Virtual Shopping Mall consists of seven spaces. The first space is the entry/selection room, where shoppers are able to select their own style of shopping. This could be by experience (for example, if shoppers want barbecue items they can buy things out of an ongoing barbecue), direct to product, random browsing, browsing with intent, or by specific stores, brand names, or product categories.

Shoppers pick up a shopping bag and head out on their adventure. They can enter theme environments based on the method of shopping they prefer, or if they want to see a specific product, they can pass through a product image, displayed in the entry room, which takes them directly to that product and others like it. Shoppers select a product by pointing to the product's picture. The product then appears as a featured three-dimensional item that can be handled and inspected. When shoppers wish to buy something, they simply place it in their shopping bag and their credit account is automatically billed. To end the shopping experience, shoppers go to the entry room and head toward the exit sign.

There is always a tradeoff between polygon count and number of possible texture maps. In this case, texture maps were extremely important in creating interesting spaces, so the complexity of models was rejected in favor of the image richness of texture maps. All the environments exist at the same coordinates. Depending on which transition symbol the shoppers pass through, the environments are turned off and on. It would be impossible to map out the Virtual Shopping Mall, because transitions are achieved by moving the shoppers' locations and angles, turning off the environments that shoppers leave, and turning on the environments that shoppers select by passing through corridors, portals, and images. This allows for endless connections and configurations based on shoppers' desires.

In Virtual Shopping Mall, the focus is on using space as a means of way-finding to allow an intuitive movement through the spaces and a progressive breakdown of architectural space. Placing shoppers in a totally foreign environment as they begin their experience would inhibit their enjoyment. The intention was to allow shoppers to immediately feel comfortable in the initial spaces, and then, as they roam farther away from the entry room, the space breaks down architecturally while retaining some spatial relationships. Particular attention was focused on the type of texture maps used, so that familiar environments were located at the beginning and less familair environments at the end. The project starts to question the materiality of space as it creates experience through imagery.

The Virtual Shopping Mall lies at the crossroads of current experience and what is to come. A generation nurtured on computers will not need such familiar representations of space. Those in transition will need them to engage new types of spaces. Over time, the mall metaphor will evolve, leaving behind the vestigial metaphorical remnants. This project demonstrates this transitional moment.

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NorthWater World

NorthWater World is a visual and aural triptych of interactive experience, of worlds within worlds, and life within lives. It is action and reaction in a wild mythic setting. The primary goal of this project is to give the user the experience of inhabiting a completely different body. The user's sight, sound, movement, and environment are changed to that of a different being. The intended result is an understanding of the other being that cannot be gained from an outsider's viewpoint.

Users start by being drawn into the body of an Arctic wolf. They find themselves just above ground level, seeing primarily in black and white. If they tip their heads up, they sit back and howl. If they tip their heads down, they see their wolf feet and hear sniffing. Suddenly, the world is imbued with color because the wolf's main sense is smell. If users lean forward, they start running across the ice in the direction they are looking. Above is the pitch black northern sky with glowing northern lights. All around are the jagged edges of icebergs. The cold hiss of windblown snow is clearly audible. After two minutes of exploring the wolf's body, users hear the boom of cracking ice and see a jagged black edge rushing at them. Suddenly, they fall into the frozen water in a cloud of bubbles.

Now users inhabit the body of a white fur seal, swimming under the ice. Above them is the frozen ice floe. Beside them are the massive bases of icebergs lodged in the ice. Below them is the black depth of the ocean. They hear the snap and boom of ice cracking, the singing of whales, and other ocean noises. The sounds are louder than in the open air, and they seem to travel forever. The seal is not limited to two-dimensional movement; it can swim up and down and turn and roll. Users move by leaning, stooping, and bending. A change in direction causes users to shoot off in that direction. Holding still results in a long, smooth glide. Schools of fish react to the seal's presence by desperately swimming away, but they are not fast enough to escape. If the seal chases a fish, the seal will catch it, rip it apart, and eat it.

After two minutes of exploration in the seals' upside-down landscape, users are drawn into the ice itself. There they find themselves drawn completely out of their bodies into a bodiless viewpoint among the abstract geometric planes of the ice. They hear crystalline shimmering tones that spin and swirl. They discover that they can create music by moving, triggering tones from the ice around them. After a minute of playing in the ice crystals, the virtual world fades away and users find themselves back in their own bodies again, with memories of being something else. The experience has lasted only five minutes but the memory of being something else, somewhere else, will remain for years.

Group Philosophy
The purpose of the Boston Computer Society Virtual Reality Group is to provide an ongoing forum for bringing scientists and developers together with VR enthusiasts and potential users who do not normally attend VR industry gatherings. By exploring both the technology and its cultural implications, exposing each to the other's thoughts and ideas, the group can help shape the future of the medium.

Project History
This year's project grew over several meetings and a long on-line discussion among the members of the BCS VR group. Everyone felt that the virtual medium could be used for much more than video games and architectural walkthroughs, and taking the user to another body seemed like a wonderful challenge. At first, the more technically grounded members of the group questioned whether it could be done with current technology. But as the discussion continued, it began to seem possible, and the group set out to design NorthWater World.

Future Impact
NorthWater World is pushing the technology to see how far it can go in providing the user with an understanding of a different life form. This is a first step toward the ability to make people understand diverse problems and diverse cultures by taking them inside the subject and allowing them to experience it first-hand.

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HARDWARE DONORS
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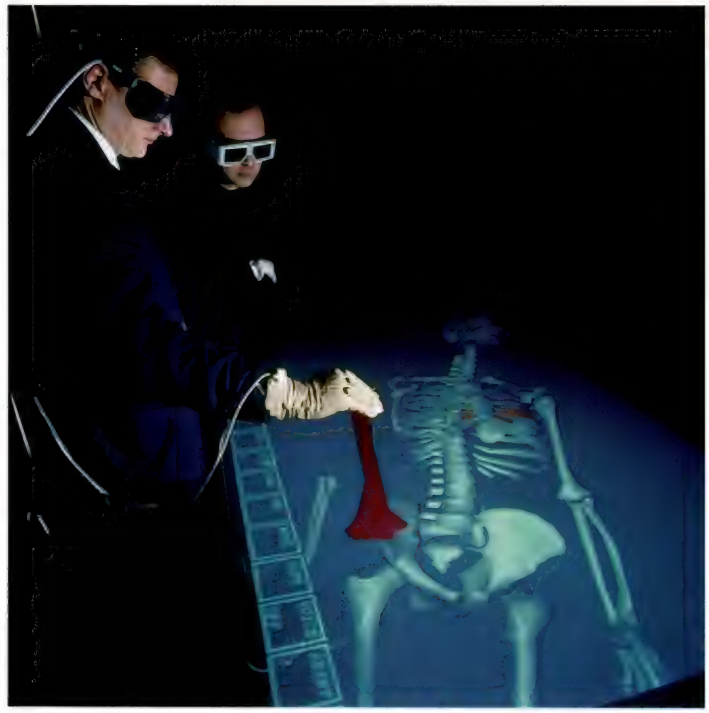

The Responsive Workbench: A Virtual Working Environment for Architects, Designers, Physicians, and Scientists

The standard metaphor for human-computer interaction has been based on the daily experience of a white-collar office worker. For the last 20 years, more and more enhanced desktop systems have been developed to provide the user with tools such as line and raster graphics, window-icon-mouse-pointer graphical user interfaces, and advanced multimedia extensions. With the advent of immersive virtual environments, the user finally arrived in a 3D space. Walk-through experiences, manipulation of virtual objects, and meetings with synthesized collaborators have been proposed as the special human-computer interfaces for the scientific visualization process.

There is another approach to the design problem for future human-computer interfaces. Based on the early ideas of Myron Krueger, non-immersive interactive multimedia environments have been developed. Basically, they are centered rigorously on the user's point of view. Application-oriented visualization environments have been proposed and built to support specific problem-solving processes. In these systems, the computer acts as an intelligent server in the background, providing information across multi-sensory interaction channels.

The Responsive Workbench has been developed as an alternative model to the multimedia and virtual reality systems of the past decade. Analyzing the daily working situations of such different computer users as scientists, architects, pilots, physicians, and service people in travel agencies and at ticket counters, the developers recognized that almost nobody wants to live with simulations of their working worlds in a desktop environment.

Generally, computer users want to focus on their tasks rather than on operating the computer. The future computer system should use and adapt to the rich human living and working environments. It should be designed to work as a part of a responsive environment. From the beginning, the Responsive Workbench has been designed by an interdisciplinary group that includes a designer, an architect, and physicians.

The architect's point of view: The ultimate design environment is and will be the designer's desk: "The tableau is the place where objects come together" (J. Beaudrillard). Design is a process which is based on a dynamic, free-floating interaction between brain, eyes, hands, and the environment: "The hand is the exterior brain of the human" (I. Kant).

Comments of physicians: The center of interest is the patient or the education process, not the operation of computer equipment. The typical working situations are cooperative tasks

amongst specialists around a table, on which the patient is positioned for surgery, radiation treatment, medical education, and other procedures.

Scenario

Virtual objects and control tools are located on a real "workbench." The objects, displayed as computer-generated stereo images, are projected onto the surface of the workbench. This setting corresponds to the actual work situation in an architect's office or an operating room. A guide uses the virtual working environment as several observers watch events through stereo shutter glasses. Participants operate within a non-immersive virtual environment. Depending on the application, various input and output modules can be integrated, such as motion, gesture, and voice-recognition systems, which characterize the general trend away from the classical human-machine interface. Several guides can work together in similar environments either locally or by using broadband communication networks. A responsive environment, consisting of powerful graphic workstations, tracking systems, cameras, projectors, and microphones, replaces the traditional multimedia desktop workstation.

Two scenarios have been realized so far:

• The design and discussion process in architecture, landscape architecture, and environmental planning. An architectural model is shown on the workbench. In front of the table, two architects discuss the model, moving buildings or other objects such as trees around in the virtual world. Light sources can be set by the data glove to simulate different times of day. For this environment, the concept of active objects appears to be essential; e.g., cars driving around or pedestrians walking along the street. Objects such as trees can be added and relocated. The problem of generating an animation path for each object is easily solved by an additional Polhemus, which can be moved around in the virtual world like an object to be animated. The Polhemus generates the position, orientation, and velocity data for the animation path.

• Surgery planning and non-sequential medical training. This application shows a resizeable model of a patient, called the transparent woman, in a teacher-student scenario. The patient's skin can become transparent, and the arrangement of the bones becomes visible. Then it is possible to pick up a bone with the data glove and examine the joints to which it connects or take a close look at the bone itself. A different scenario is surgery planning with virtual bodies that originate from real datasets derived from CT or MRI measurements.

Future applications and systems extensions

During discussion of the Responsive Workbench concept, the setup of the whole system, and realization of the first application scenarios, the developers came up with the following ideas for improvements and extensions:

• Enhancement of the system's I/O and rendering tools.

• Inclusion of other applications, suited to this specific environment.

• Design of appropriate responsive environments for other classes of users.

The Responsive Workshop is designed to demonstrate the ideas and power of future cooperative-responsive environments. Further applications for this virtual workbench will be an adapted "virtual wind tunnel" for car design, simulation of air and ground traffic at airports, a training environment for complicated mechanical tasks (e.g., taking apart a machine for repair, landscape design, and environmental studies via terrain modeling), and modeling of virtual objects ("virtual clay"). These applications also rely on the workbench metaphor, but require specific interaction and I/O tools.

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PolyShop

An eight-year-old girl builds a fairy tale castle from blocks, then shrinks herself down to a size where she can go inside her castle to play.

A SWAT team penetrates a building and rescues hostages within minutes. The team has not previously been in the building. Or have they "visited" the location before?

A student in France and a student in the United States stroll together through a landscape of changing objects. As each new object appears, they teach each other a phrase about it in their native language.

Previously, these experiences were only available through imagination. Now, networked virtual reality is opening up new channels of communication. PolyShop is an attempt to create an immersive, interactive, responsive virtual environment as the underlying technology for a variety of applications that allow humans to not only exist in but also to manipulate the virtual world.

PolyShop is unique for several reasons. One of its most interesting aspects is the direct mapping between the virtual and the physical worlds. In order to decrease the fatigue caused by reaching out to interact with objects in the virtual world, PolyShop allows an application to be built around an actual desktop. For lengthy and exacting applications such as geometric modeling, the user sits at a drafting-table-style desk that is specially constructed to minimize interference with the trackers. The desktop is recreated as a 3D geometric model and displayed in the virtual world. The testbed is calibrated so that the physical and virtual desktops correspond. The desktop can be tilted to a comfortable angle for working, and the virtual model tracks it and tilts as well.

Another innovative aspect of PolyShop is found in its manipulation metaphor. Interaction with the virtual word is through a pair of chord gloves that have conductive pads on the palms and fingertips to detect simple electrical contacts. They can be used to emulate 3D mice or a chordic keyboard in a virtual environment, or as an intuitive picking interface. While wearing the gloves, the user can simply reach out and pinch on an object to select it at a precise point. While grasping an object with both hands, the user can rotate, stretch, or scale it just as if it were in the real world. The power of this interface is illustrated in one of PolyShop's baseline human factors tests, in which the user can scale, rotate, and translate a puzzle piece in one intuitive motion.

Once these basic abilities were established, more complex tools were added to PolyShop's repertoire. Cursor snapping and pivot points were developed to increase control and accuracy. By placing a pivot point between two objects, full-face alignment in 3D can easily be achieved. This, combined with the ability to texture, color, and glue objects together to form more complex objects, creates a powerful 3D modeling interface.

Modeling is, however, only one of the countless applications that are moving toward virtual environments. Long-distance networking allows two or more participants to enter PolyShop's environment for collaborative work, education, and training activities, or multiperson games. Adding sound gives the virtual space an extra dimension. Voice recognition increases the interaction bandwidth. Attaching behaviors to objects can create virtual shooting stars and scurrying insects. PolyShop gives the user the freedom to ignore real-world physical laws, which unleashes creativity and forges a new and unique interactive artistic medium.

PolyShop's History

Funding for PolyShop as a networked virtual CAD environment is provided by the Army's Simulation, Training and Instrumentation Command (STRICOM). The first-year (1993) effort focused on a low-cost prototype platform. Two 486 PCs with SPEA Fireboards were used, with one PC generating the geometry for each eye. A Polhemus Fastrak with three sensors was utilized for the spatial tracking of the head and both hands, and the display was fed to a Virtual Research Flight Helmet.

The chord gloves, which were designed and developed at the Institute for Simulation and Training, detect electrical contact with a Motorola HC11 development card. Extra functionality was added with DragonSpeak and GUS cards, used for voice recognition and sound, respectively. A specialized drafting table was designed and constructed in conjunction with University High School. The software was built on top of Sense8's World ToolKit, a C library which afforded both quick prototyping abilities and an easy port-up to a high-end graphics system in the second year of the project.

PolyShop combines cutting-edge VR technology with the inspiration of the human spirit and provides a responsive and highly intuitive virtual creation space. Several different demos are shown, including a virtual jigsaw puzzle and the 3D modeling environment, where users will be able to create their own worlds.

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A Virtual World for an Autonomous Underwater Vehicle

The problem: A critical bottleneck exists in autonomous underwater vehicle (AUV) design and development. It is tremendously difficult to observe, communicate with, and test underwater robots, because they operate in a remote and hazardous environment where physical dynamics and sensing modalities are counter-intuitive.

The solution: An underwater virtual world can comprehensively model all salient functional characteristics of the real world in real time. This virtual world is designed from the perspective of the robot, enabling realistic AUV evaluation and testing in the laboratory. The window into the virtual world is 3D real-time graphics technology.

AUV development difficulties: The primary difficulty facing AUV developers is a challenging physical environment. An operating AUV is inaccessible, remote, and unattended, and there is clear empirical evidence of a severe bottleneck in underwater robotics.

There are perhaps a dozen working AUVs in existence, each with limited functionality. AUV failure in the ocean is unacceptable for several reasons: any failure may become catastrophic, recovery may be difficult or pointless, and replacement costs in time and money are prohibitive. Reliability, stability and autonomy are paramount, AUV constraints are often worst-case for any type of robot due to the underwater environment, and many theoretical and engineering problems remain open.

Why an underwater virtual world? "Virtual world system... characteristics are seeing and interacting with distant, expensive, hazardous, or non-existent 3D environments. The technology for 'seeing' is real-time, interactive 3D computer graphics and the technology for 'interacting' is evolving and varied." (Zyda 1992) The current underwater robot development paradigm is inadequate and costly. Piecemeal design verification and individual component simulations are not adequate to develop and evaluate artificial-intelligence-based robot systems. Virtual-world systems allow people or robots to see and interact within synthetic environments. The research goal is to provide a completely functional target environment in the lab, with adequate simulation scope and interaction capability to overcome the inherent design handicaps of classical simulation approaches. AUV virtual worlds may break the AUV development bottleneck.

AUV virtual world characteristics: The underwater virtual world must recreate the complete environment external to the robot. Robot sensors and analog devices must be modeled accurately. The behavior of robot physical dynamics must be adequately simulated, since underwater vehicles are prone to non-linear dynamic instabilities and unpredicted physical responses may result in vehicle loss. To minimize sources of simulation error, an exact copy of robot hardware and software is plugged into the virtual world using physical or logical sensor and actuator connections. The difference between operation in a virtual world or an actual environment must be transparent to the robot. Finally, successful implementation of a virtual world can be validated by identical robot performance in each domain. This is a type of Turing test from the robot's perspective: if robot performance is identical in each domain, then the virtual world is functionally equivalent to the real world.

Sonar visualization: Visualization of robot sensor interactions within a virtual world permits sophisticated analyses of robot performance that are otherwise unavailable. Sonar visualization permits researchers to accurately "look" over the robot's shoulder or even "see" through the robot's eyes to intuitively understand sensor-environment interactions. The overwhelming size and information content of ocean and robot datasets means that visualization is essential to extract meaning from numerous simultaneous quantitative relationships. Visualization of the robot in its surroundings greatly improves human understanding.

Networking: Distribution of underwater virtual world components enables scalability and real-time response. The IEEE Distributed Interactive Simulation (DIS) version 2.0.3 protocol is used for compatible interaction with other virtual worlds listening on the Internet. This project is an excellent application to take advantage of a high-bandwidth information superhighway, which can further extend the capabilities of multiple researchers. The network approach allows many individuals dynamic remote access, which is demonstrated by MBONE transmission of video, graphics, and sound for collaboration with other participants outside The Edge. Providing hypermedia access via publicly available World Wide Web network browsers such as Mosaic makes a complete variety of pertinent archived information available to anyone, including images, papers, datasets, software, sound clips, text, and any other computer-storable media.

A new paradigm shift in the making? Within two lifetimes, we have seen major paradigm shifts in the ways that people record information. Handwriting gave way to typing, and then typing to word processing. It was only a short while afterwards that preparing text with graphic images became easily accessible, enabling individuals to perform desktop publishing. Now, people can use 3D real-time interactive graphics simulations and dynamic "documents" with multimedia hooks to record and communicate information. This project indicates the possibility of a paradigm shift for researchers. The long-term potential of virtual worlds is to serve as an archive and interaction medium, combining massive and dissimilar datasets and datastreams of every conceivable type. Virtual worlds will then enable comprehensive and consistent interaction by humans, robots, and software agents within those massive datasets, datastreams, and models that recreate reality.

Research conclusions: Construction of an underwater virtual world is feasible. Using 3D real-time graphics in an underwater virtual world enables effective AUV development. Visualization of robot interactions in an underwater virtual world improves our perceptual ability to evaluate robot performance. A networked robot and virtual world makes robotics research and collaboration accessible worldwide. This project presents the frontier of 3D real-time graphics for underwater robotics, ocean exploration, sonar visualization, and worldwide scientific collaboration.

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The Edge Observatory: An Airborne Telepresence System

The Edge Observatory Telepresence system offers its operators the unique ability to visually "teleport" themselves to a remote location in the airspace above The Edge. Suspended by a helium balloon, a small motion-controlled video camera acts as the eye of the operator below, matching angular orientation with the user's head position and feeding the video signal from above back to the operator's head-mounted display. Such an airborne telepresence system offers the user unique visual feedback in environments that are unsuited for airplanes, helicopters, or other airborne equipment. The probe's unique size and weight render it useful for indoor use as well, making it an option for applications ranging from trade show advertising to unmanned television blimps. The overall goal of the observatory project is to raise public awareness of the many possibilities of telepresence.

From the start, the main goal of The Edge Observatory Telepresence system has been to demonstrate a practical example of how this technology has matured and become commercially feasible. Unlike computer-based virtual reality, telepresence does not require expensive computer processing power, since it does not simulate an environment; it simply transfers environmental information from one location to another. In the observatory system, the visual perspective as seen from a balloon above the conference is transferred down to the user below, who is wearing a head-mounted display (HMD). A miniature computer-controlled motion platform orients the balloon's video camera in accordance with the operator's head position, allowing the user

to look around freely. The system puts a new twist on previous exhibits by offering a view from 40 feet above the conference.

In developing The Edge Observatory project, special consideration was given to the cost and commercial availability of the components. Except for the custom software and the mechanical structure of the video camera platform, all components were purchased at low cost from toy and hobby stores and inexpensive sources within the virtual reality industry.

The camera platform was built with a toy construction kit (Steel Tec) and servo units that are commonly used in the remote control toy/hobby market. Pitch and yaw (up/down, left/right) were implemented with two servos. Roll was omitted, since it greatly increases the mechanical complexity of the design without offering much in enhanced motion-control. A small, lipstick-sized CCD video camera was the ideal choice as a video source, since its low mass makes it suitable for quick angular accelerations and keeps the total system weight to a minimum. The entire camera and motion platform assembly can fit nicely into the palm of a hand, and it weighs about nine ounces. Although a tether is used with the observatory, the servos are uniquely suited for operation with remote-controlled equipment, since they were originally designed for such systems. The only additional requirement for wireless operation is an NTSC signal-transmission system.

A VictorMaxx head-mounted display is used along with a DigiSonic, Inc. ultrasonic head tracker. This combination offered the only fully head-tracked display for under $1,000. The video signal from the camera is fed directly into the color display, and head tracker information is fed into the computer via an internal ISA peripheral.

The computer system is a low-cost 386 PC, which acts as a buffer between the head-tracking device and the motion-control system. It analyzes the head tracker orientation and matches the video camera orientation to its equivalent. The computer also stabilizes erratic accelerations and vibrations within the motion platform. If a user moves too erratically, the computer relaxes these accelerations to protect the servo system and the CCD camera from excessive forces. Orientation information is then delivered to the servos via a servo I/O board connected to the serial port.

Telepresence and telerobotics have fast-growing commercial applications and will have a profound impact on future developments in space exploration, underwater operations, and military combat. Airborne telepresence is especially well suited for terrain reconnaissance and theme park rides. Commercial advertising has yet to take advantage of the high visibility and crowd participation potential of telepresence systems such as The Edge Observatory.

An airborne telepresence probe provides simple but powerful proof that one can fly without actually leaving the ground. It is hoped that this timely and educational display conjures up new ideas for future development.

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The Personal Flogistabarium Release 1.0 Name of Experience: Waving

The purpose of this project is to introduce the concepts of threespace, the integration of cyberspace with realspace and mindspace. This shift from a bipolar reality to a tripolar reality is a significant development in the evolution of man. The personal flogistabarium demonstrates the experience of living in threespace. Because cyberspace exhibits properties more like mindspace than realspace, the simulation expresses the internal void. Rather than virtual reality, this is virtual mindspace. Visitors go waving in this space.

Description

A visitor reclines in the neutral posture of the flogiston chair. Above and close by, at an angle, is an 8-foot by 5-foot curved screen which occupies the visitor's full vision. An HDTV projector mounted behind the screen back-projects real-time imagery. The entire system is installed inside a black dropcloth enclosure that keeps out all external light. A surround-sound system with six speakers supplies audio. Alternatively, a high-resolution HMD can be used if its configuration can meet weight, resolution, and ease-of-use requirements.

The personal-motion platform supplies motion cues and low-frequency vibration to the occupant. The combination of the neutral posture and the motion cues provides a sense of floating or flying in cyberspace when coupled to the imagery and sound. This increases the fidelity of the experience and the sense of experiential immersion.

The experience is simplified to reduce the learning curve within the short time available. Control is limited to leaning the chair in the direction the visitor wants to go. This is intuitive and should be simple to master within the first minute. Alternatively, a Logitech Cyberman can be used as a joystick.

The visit starts with the visitor leaving the ground and joining fellow virtual visitors in a flying-V formation through the dark night. Motion cues provide the sense of rising into the sky. The visitors fly upward toward the moon, which turns into a space tunnel through which they enter cyberspace. The imagery, vibration, and music combine to form a vision of deep mindspace, where flow is the only experience – the optimal experience, as Csikszentmihalyi calls it. Stress is reduced, the body is forgotten, and consciousness is lost in deep peace. The visitor coasts for a few minutes in the void of cyberspace and then is gently returned to realspace. The effect is an unforgettable positive experience of wonder and expectation: "This is the way to the stars…"

The flogistabarium consists of:

1. Flogiston chair

Neutral posture chair that supports the body in a minimal-stress posture similar to the posture experienced in zero gravity. It uses long memory foam and soft fabric or leather finish to provide optimum comfort. This posture helps the visitor to reduce the "normal" focus on realspace and focus on the mindspace/cyberspace connection.

2. DDL Motion bases

Three-degree-of-freedom motion bases use Pemram thrusters to provide motion. These thrusters are being developed for Flogiston by DDL and Lotus Cars for NASA's SBIR development of the personal motion platform for training astronauts. The platforms and chair for the threespace system are identical to the NASA training platform. Each platform has its own controller networked to the virtual-reality processor. The platform provides pitch, roll, and heave as well as low-frequency vibration and the capability to tilt up for easy entry and exit.

The motion is gentle, not the abrupt stop-start motion typical of location-based-entertainment systems. The sensation of floating in a relaxed fashion is important to promote the feeling of detachment from realspace. Gentle vibration at key frequencies adds to the effect.

3.a. HDTV
A Sony HDTV projector back-projects on to a curved screen that immerses the visitor in imagery. The screen is close to the face – about 27" for eye rest distance – and curves so that the edges are beyond peripheral sight. The visitor is immersed in the image.

OR
b. HMDs
State-of-the-art head-mounted displays containing high-resolution LCD displays and stereo sound. Units are lightweight and may be supported off the face by a chair-mounted articulated arm to eliminate face loading.

4. VR system
A workstation with a Reality Engine by Silicon Graphics, Inc. powers the system's high-resolution, seamless real-time animation.

5. Software by Eric Gullichsen
The virtual reality operating system that controls the virtual worlds. Eric is a world-class programmer now into his third-generation VR operating system.

6. Sound by Thomas Dolby
A combination of sound effects and music provides an electrifying sonic experience. With the assistance of Dr. Fiorella Terenzi, sound signatures of planets and space are sampled and adapted to provide a continuous backdrop to the images and a prevailing sense of musical flow and endlessness.

The aural music can be complemented by infra-sound music (sounds in the frequency range of 0 to 16 Hz, known as Waving). A harmonious vibration can accompany the visuals to provide a complete body/mind experience. In addition, the bases can be resonated at various frequencies when high-energy density is required at transition points into threespace.

7. Cyberspace development by Steve Speer and Jason Rice
The key to the entire experience is the spaces that the visitor experiences. This introductory trip has been developed by Steve Speer, one of the world's leading cyberspace artists working in the new medium of virtual worlds. Jason Rice did the programming for the Hughes Mirage VR location-based-entertainment system. He is also an accomplished musician and fellow visionary.

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Inside/Out
Figurative Sculpture

These "digital sculptures" draw upon recent advances in 3D laser digitizing and rapid prototyping technology. They utilize the unique space of the computer to pre-visualize problems of viewer position, time, and three-dimensional montage. Surface "maps" of the body or other forms are created using 3D laser digitizing equipment. This surface topography is then sent to a Silicon Graphics platform where it is evaluated and modified using custom software. Finally, the desired dataset is sent to a CNC (computer numerically controlled) mill, where it is translated into tangible, three-dimensional form.

Three goals animate the project:

1. A desire to test the conventions specific to the traditions of figure sculpture.

2. A desire to understand rapid prototyping technology and its relationship to three-dimensional computer modeling.

3. A need to critically examine how our technologically driven culture shapes both our current image of the body and how we understand three-dimensional form.

The difficulty in gaining an integrated "picture" of ourselves is, in large measure, reflected by the disparate methods we as a culture use to represent the body. Essentially, this series of digital figure sculptures is a first step for the artist in providing bridges between contemporary aesthetic discourse and scientific visualization. The hope is to provide an expanded model of how we currently represent ourselves to one another.

The uniqueness of this project, both technically and aesthetically, resides in testing the limits of a system developed by Cyberware, Inc. In each stage of the process, I investigated methods that went beyond the "acceptable" limits of the system. For example, with regard to the 3D laser digitizing capability of the system, I explored how physical movement would affect the nature of the captured data set.

The work titled "Of More Than Two Minds" is the result of my turning my head at approximately the same rate as the laser digitizer as it made its circular pass around my body. The resultant dataset constituted a three dimensional blur. The effect has much in common with a conventional photographic blur in which the speed of a subject exceeds the camera's ability to freeze the action. As a complete scan of a three-dimensional object takes seventeen seconds, there is ample opportunity for combining static and dynamic elements within a single pass of the scanner.

I was most interested in the pre-visualization and modeling capabilities of the computer platform itself relative to an arcane perceptual effect known as "anamorphosis" (literally, "against form"). The appearance of anamorphosis as a consciously applied technique in the history of art is nearly simultaneous with the invention of linear perspective. Anamorphic projection seeks to deny the usual conventions of "looking" in which an observer views an image frontally from a limited range of viewing angles. It is a technique of disruption and distortion. The crucial difference from classical perspective is that an observer positioned to receive the undistorted view of an anamorphic image would have to be at a radically oblique angle to the picture plane – and, not incidentally, have one eye shut to overcome the corrective effects of binocular vision. This monocular, self-conscious gaze – exaggerated proof of the "cone of vision" that explains classical perspective – presumes a subjective viewpoint that reinscribes the source of vision in the physical body.

My initial experiments with anamorphosis involved two-dimensional smears using conventional optically-based projection systems. In moving into three-dimensional anamorphic forms, I first utilized closed-circuit video cameras to provide the necessary vantage point and monocular view. The computer, however, has proven to be the ideal anamorphic instrument. It is relatively easy to modify three-dimensional datasets in the space of the computer to produce accurate anamorphic distortions. These can be previewed from a range of vantage points to determine whether the reclaimed image will be effective in the finished sculpture. In the sculpture titled "Eye On the Prize," the image of an upturned head, its tongue licking its lips, has been extruded nearly to the point of unrecognition. But when one stands over the sculpture and closes one eye, the reclaimed image is fully apparent.

It is not suprising that with increased use of computers – and, concomitantly, of video – one finds a corresponding exploration of these media's anamorphic potentials. It is in the realm of computers that anamorphosis may have the most significant impact: less as a technique for distorting form, than as a metaphor for understanding the biased methods we use for storing, processing, and retrieving information.

In the highly abstracted, binary systems of order that make computers possible, one finds a model in which the anamorphic transformation of a given field of information is the rule rather than the exception. Fundamentally, everything is reduced to a plus/minus code; there is no room for that which cannot be submitted to a binary operation.

A process of compressing and subsequently decompressing information – the digital version of perspective foreshortening – characterizes the world of computers. While the result of such processes may not yield a "stretched" image or be dependent on a radically oblique vantage point, I would argue that the spirit of the operation is essentially "anamorphic." Such a view resonates with Donald Preziosi's use of the "panopticon" and "anamorphosis" as "guiding metaphors" for understanding how knowledge is organized and accessed:

"Any form of disciplinary knowledge is a panoptic, anamorphic apparatus: what is visible is legible only from a particular perspective that both reveals objects of a domain and occludes other objects and other possible domains." (Donald Preziosi, *Rethinking Art History*, New Haven: Yale University Press, 1989, pp. 76-77.)

My current work involves integrating diverse human body representations (CT scans, MRI imges, ultrasound, stereophotogrammerty, etc.) using digital mapping techniques and stereolithographic rapid prototyping. Much as the anatomical drawings of Leonardo and Vesalius highlighted correspondences between external form and internal physiology, the current work seeks to link the discourse surrounding how we represent the body with recent advances in visualizing the human anatomy.

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Virtual Photography/ PHSCologrames

Most work in virtual reality concerns itself with real-time, immersive interaction. Much attention has been devoted to the development of head-mounted and other displays, but the options for a permanent, hard-copy record of virtual environments are limited to one: PHSCologrames. Developed in 1988 by (Art)^n Laboratory, PHSCologrames are full-color, 3D hard copy images that are created directly from digital 3D imagery. They can be created using nearly any software capable of creating 3D images, such as Alias, Wavefront, or AVS, or from digitized real-world photography. The software is used to generate a number of views, typically 13, although recent work makes it possible to use well over 100 images. Higher numbers of images allow for more depth and special effects, such as limited animation.

(Art)^n's proprietary system interleaves (combines) these views, which are then output on a high-resolution output device. The output is laminated onto the back of a .25-inch-thick piece of Plexiglas. The line screen – a black piece of film containing clear, vertical slits – is laminated to the front of the Plexiglas, where it blocks out 12 of the 13 images at different angles. Because the viewer's eyes are positioned at different angles to the finished PHSCologram, a different image enters each eye, producing the 3D effect.

The line screen has the additional effect of reducing the amount of light transmitted by the image. To counteract this, the PHSCologram is backlit in an ordinary light box. If backlighting is unsuited to the desired application, the line screen can be replaced by a lenticular screen – a series of molded, extruded, or cast vertical lenses that focus light to produce the same effect as the barrier screen. Lenticular screens have several disadvantages, however, most notably the additional expense and time of tooling and manufacture. Line screens, in contrast, may be produced inexpensively on the same output device used for printing the image.

Autostereographs created with line screens and lenticular screens have been seen for nearly a hundred years. They have been made using a variety of optical means, ranging from the elegant to the Byzantine, but they all suffer from the typical inconsistencies of analog processing. PHSCologrames represent a monumental advance because they eliminate the analog steps, replacing them with a carefully controlled computer simulation of the analog process.

(Art)^n's proprietary PHSCologram software can be easily incorporated into a virtual reality system. A 3D graphical icon of a virtual camera would exist in a virtual space. The user would manipulate objects in this space and take pictures with the virtual camera. When the button on the camera is pressed, the computer renders a series of views for the PHSCologram, typically at higher resolution and quality than the virtual environment. These views can then be automatically interleaved and output on an Iris inkjet printer or Kodak Premier full color output device and easily viewed away from the VR workstation.

Further research in this direction includes creation of a simple user interface for a VR environment and development and integration of a PHSCologram server system. Such a server would handle the details of off-line rendering, interleaving, and spooling to the output device, thus increasing throughput and allowing image output without impacting performance for the VR participant.

In 1983, Ellen Sandor, an MFA in sculpture from the School of the Art Institute of Chicago, established (Art)^n Laboratory. The group's name was chosen to indicate the unlimited potential for collaboration among the arts, science, and cutting-edge visual technologies. In the mid-1980's, (Art)^n worked with Dan Sandin and Tom DeFanti at the Electronic Visualization Lab at the University of Illinois at Chicago and Larry Smarr and Donna Cox at the National Center for Supercomputing Applications at the University of Illinois, Urbana-Champaign. In 1987, the results of this collaboration were first shown at Fermilab in Batavia, IL. This collaboration brought about the most significant collection of scientific visualization 3D hard copy. In 1988, Stephan Meyers developed the PHSCologram software. A patent was granted for the PHSCologram process in 1992, and (Art)^n has several new patents pending.

(Art)^n's work has been exhibited widely in international museums and galleries. Recent exhibitions include "From Media to Metaphor: Art About AIDS", a traveling exhibition organized and circulated by Independent Curators Incorporated, and "(Art)^n/Virtual Photography," Rhona Hoffman Gallery, Chicago. The latter show included virtual portraits created in collaboration with Christopher Landreth, Chuck Csuri, SimGraphics, and Colossal Pictures.

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Guerrilla Gallery

Guerrilla Gallery is a working atelier that provides a rich interactive experience for works-on-paper artists and the entire SIGGRAPH community. The gallery features a fully equipped imaging studio, in which artists can produce digital prints from their own files. Studio equipment features an IRIS ink jet printer operating from a Macintosh platform. Other peripheral equipment facilitates the exploration process.

Artists have the opportunity to talk with service bureau and manufacturing representatives as they work. This will provide a much-needed venue for discussion of the technical aspects of translation from image file to digital fine art edition. Attendees from other disciplines will also have the opportunity to interact with artists, which should foster a new level of appreciation and understanding within the community.

Artists work independently and collaboratively in the gallery, conduct ongoing communication about their works in progress, and return "high-touch" to "high-tech" through experimental works from digital prints. One of the most important aspects of the gallery will be its function as a meeting place, where SIGGRAPH 94 artists can hold ongoing dialogue about their work. The need for this exchange was established at SIGGRAPH 93 during a week-long series of stimulating Birds-of-a-Feather meetings on topics ranging from digital printing methods to marketing. Works-on-paper artists were able to share entire bodies of work and discuss technical and aesthetic questions. Maryann Doe of Harvest Productions presented illuminating insights on the role of the fine-art service bureau. Question-and-answer sessions with manufacturers and developers were invaluable. The Guerrilla Gallery is based on suggestions and encouragement from artists who attended these sessions.

The Guerrilla Gallery offers a series of similar presentations at The Edge. Scheduled portfolio and slide presentations by selected artists provide inspiration and a springboard for conversation about art making. Though digital prints are not a new idea, works-on-paper artists are still challenged by questions regarding the legitimacy of digital prints as limited editions. The Guerrilla Gallery provides a forum for discussing reservations about the digital edition and other topical questions.

Activities in the studio include

• Atelier sessions using the equipment provided to produce digital prints

• "Artists Talk on Art" sessions with portfolio and slide presentations of works in progress.

• Discussion of standards and documentation requirements for digital fine art editions.

• Question-and-answer sessions with manufacturers and service bureaus designed to answer the unique questions fine artists have about the digital printing process.

• Experimental printing workshops to expand the artists' scope and vision.

Guerrilla Gallery activities are planned and scheduled by Pat Johnson in collaboration with Alan Jones of IRIS Graphics and Dorothy Krause of the Massachusetts College of Art.

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Desktop Force Display

Force sensation plays important roles in the recognition of virtual objects. In this display, users can feel the rigidity or weight of virtual objects with a compact force-feedback device (force display) for desktop use.

A six-degree-of-freedom manipulator employs a parallel mechanism to apply reaction forces to the fingers of the operator. The manipulator's handle is supported by three sets of pantographs. With this compact hardware, the operator can feel the physical characteristics of three types of virtual objects:

1. Hard surface
Reaction force from the virtual surface is applied to the user's hand. The user cannot penetrate the surface. This demonstration shows large payloads of the force display.

2. Elastic surface
The user can push and deform the surface. Reaction force increases in proportion to the deformation. This demonstration can be applied to 3D shape modeling.

3. Flow
Fluid velocity is represented by force, and vorticity is represented by torque. When the user places a hand in the fluid, resistance from the flow can be felt. If the user's hand comes to vortex, it is twisted. This demonstration can be applied to scientific visualization.

These three objects are located in the working space of the force display. No visual image is presented to the user. The user gropes around in the virtual space for two or three minutes per demonstration. The system does not require instruction or calibration for individual differences, so 20 to 30 people can experience the demonstration each hour.

Most robotic manipulators have large-scale and high-cost hardware, which inhibits their application to human-computer interaction. This innovative force-feedback device was specifically developed for desktop use. It provides haptic and force feedback, which strongly enhances human capabilities in the major application areas of virtual reality, such as scientific visualization and 3D shape modeling.

The basis of the force display is a six-degree-of-freedom manipulator that employs a parallel mechanism. The typical design feature of parallel manipulators is an octahedron called a "Stewart platform," in which a top triangular platform and a base triangular platform are connected by six length-controllable cylinders. This hardware design is compact, and it has the ability to carry a relatively large payload, but the structure has some practical disadvantages in its small working volume and the mechanism's lack of backdrivability (reduction of friction).

The Desktop Force Display system employs three sets of parallelogram linkages (pantographs) instead of linear actuators. Each pantograph is driven by two DC motors, and each motor is powered by a PWM (Pulse Width Modulation) amplifier. The top end of the pantograph is connected to a vertex of the top platform by a spherical joint. This pantograph mechanism has the same advantages as an octahedron mechanism, and it improves the working volume and backdrivability of the parallel manipulator. The inertia of the manipulators's moving parts is so small that compensation is not needed.

The same team displayed a desktop force system with the same mechanical characteristics in the SIGGRAPH '90 Proceedings. In the current work, new pantographs and spherical joints that improve the working space and working angle of the top platform were designed. The working space of the center of the top platform is a spherical volume whose diameter is approximately 40 cm. Each joint angle of the manipulator is measured by potentiometers. The maximum payload of the manipulator is 2.5 kilograms, which is more than a typical hand.

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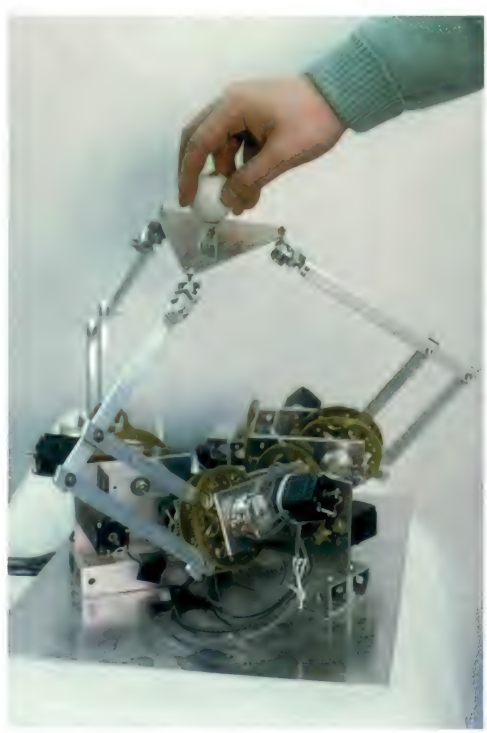

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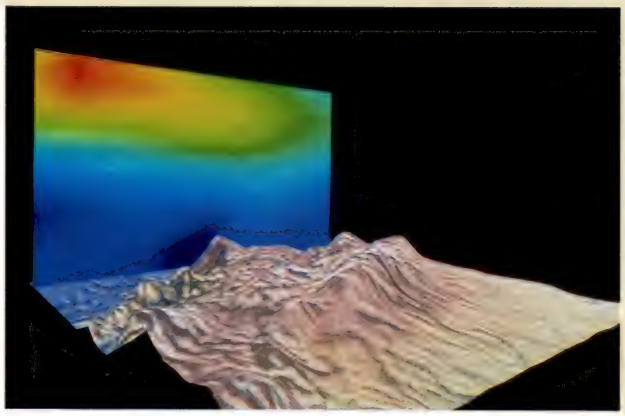
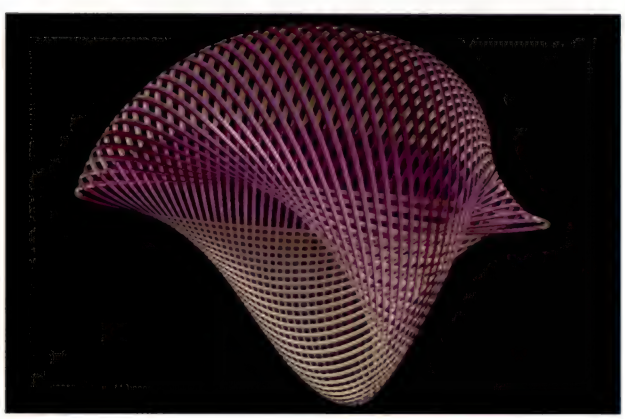




INTRODUCTION

Attendees experience the actual use and future direction of scientific visualization in computational science and engineering, with emphasis on interactive and collaborative problem solving, in VROOM, the Virtual Reality Room. Virtual environments not only enable scientists to view massive datasets, they also enable them to enter into and interact with the data. Scientists can become smaller than an atom or larger than the universe. They can stand in the middle of a thunderstorm or travel through the human bloodstream. At SIGGRAPH 94, attendees share this full-data immersion experience with the actual scientists, as the scientists conduct a guided tour and explain which areas are of interest to the high-performance computing and communications (HPCC) community.

Over 40 projects involving over 200 researchers and programmers are demonstrated for four days at SIGGRAPH 94. Using CAVE and BOOM virtual reality technologies, researchers show immersive visualizations of their work and demonstrate interactive steering of their program codes using local high-speed networking, massive datastores, superworkstations, supercomputers, and scientific instrumentation. VROOM highlights computational science and engineering applications and computer graphics research. It also has a kid-centered application component called CitySpace.

VROOM's primary goal is to encourage the development of teams, tools, hardware, system software, and human interface models on an accelerated schedule. New interaction paradigms for virtual environments tuned to science and engineering will emerge, which will be the basis for future intelligent user interfaces for the emerging national information infrastructure.

Attendees gain a vision of the 1990's scientific "cyberworkspace." Virtual reality experiences enable researchers to interactively explore their scientific domains, play "what-if" games by modifying their codes, and view the resulting visualizations in close-to-real time. Virtual reality is recognized as an "intelligent user interface" to the emerging national information infrastructure. It will allow computational scientists and engineers access to HPCC-enabling technologies, and it will put the "human in the loop" for timely data analysis and understanding.

Three CAVEs

VROOM features three CAVEs in one place! A CAVE is a multi-person, room-sized, high-resolution, 3D video and audio environment. At SIGGRAPH 94, it is a theater 10 feet by 10 feet by 9 feet with three rear-projection screens for walls and a down-projection screen for the floor. Electrohome Marquis 8000 projectors throw full-color workstation fields (1280x512 stereo) onto the screens at 120 Hz, generating a surrounding composite image of 2,000-4,000 linear pixel resolution. Computer-controlled audio provides sampled sound and sonification capabilities through multiple speakers.

A user's head and hand are tracked with Polhemus or Ascension tethered electromagnetic sensors. Stereographics' LCD stereo shutter glasses are used to separate the alternate fields going to the eyes. A Silicon Graphics Onyx with three Reality Engines is used to create the imagery projected onto three of the four walls. The CAVE's theater area sits in a light-tight room (minimally 30x20x13 feet), and the projectors' optics are folded by mirrors.

As the viewer wearing the location sensor moves within the CAVE's display boundaries, correct perspective and stereo projections of the environment are updated, and the image moves with and surrounds the viewer. Other viewers in the CAVE are like passengers in a bus, along for the ride!

"CAVE," the name selected for this virtual reality theater, is both a recursive acronym (Cave Automatic Virtual Environment) and a reference to "The Simile of the Cave" found in Plato's "Republic," in which the philosopher explored the ideas of perception, reality, and illusion. Plato used the analogy of a person facing the back of a cave filled with shadows, where the shadows are the only basis for understanding what real objects are.

The CAVE, developed by the Electronic Visualization Laboratory at the University of Illinois at Chicago, premiered at SIGGRAPH 92. It is achieving national recognition as an excellent virtual reality prototype and a compelling display environment for computational science and engineering data.

CAVE Interactive Steering of Computer Simulations

Applications can run in one or two modes: locally on the Onyx/CAVE and/or distributed between a backend computer and the Onyx/CAVE. In local mode, CAVE participants explore precomputed datasets. In distributed computing mode, CAVE participants may "interactively steer" their simulation codes running on an onsite IBM SP or on SGI Challenge multi-processor computers.

This ability enables CAVE users to experience and explore visualizations of precomputed datasets, identify an area they want to enhance, and then invoke simulation codes on the networked computer to compute new datasets. The Challenge or SP generates new data, which is then transferred to the Onyx for rendering and display in the CAVE.

Scientific simulation codes are typically large and complex. They require HPCC resources – massively parallel processors, vector processors, massive datastores, large memories, or high-speed networks – to run efficiently. Depending on the dataset and type of analysis scientists select, they set up their simulation codes to calculate greater detail, a different time step, or a different state defined by new parameters. In some instances, codes can be executed locally but take longer to run, so the Challenge and SP are used to provide faster simulation.

BOOM ROOM

The VROOM BOOM ROOM contains a collection of BOOM (Binocular Omni-Oriented Monitors) virtual reality technologies. The BOOM uses small TV screens and wide-field optics suspended by a counterbalanced mechanical arm in front of a viewer's eyes. Fakespace, Inc. developed these light-weight BOOMs to provide accurate lag-free tracking. They are driven by Silicon Graphics workstations to create virtual scenes in real time.

NCSA Mosaic

Hypermedia is an excellent mechanism for the dissemination of visualization-based discovery. Workstations displaying NCSA Mosaic-based documentation of virtual reality visualizations taking place in the CAVEs and BOOMs are located in open areas of VROOM so attendees can learn more about the science and engineering applications on display. After the conference, these documents, complete with text, images, sounds, and animations, are available over the Internet, under the Electronic Visualization Laboratory home page.

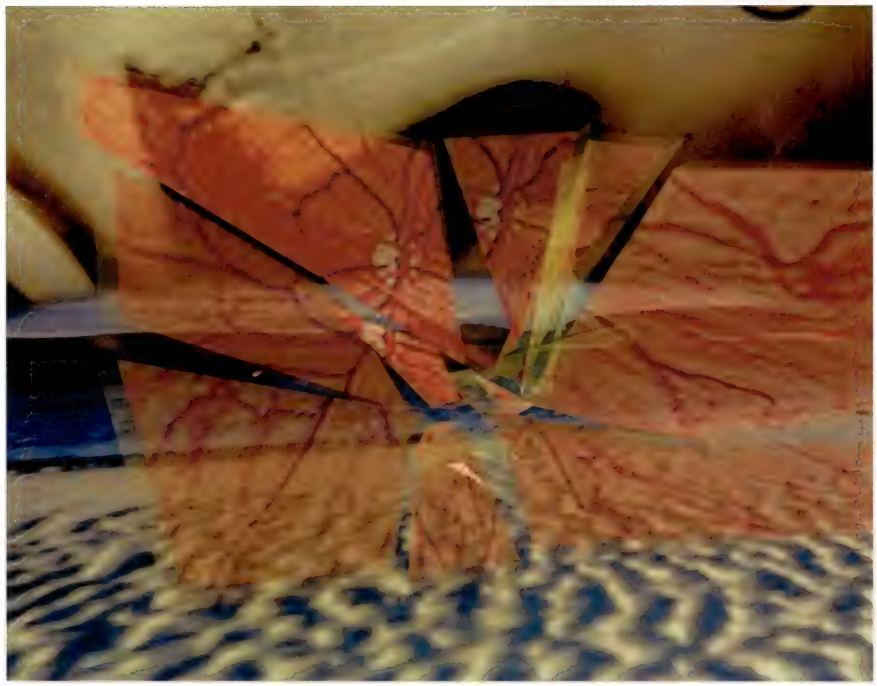
NCSA Mosaic is a hypermedia-based system for discovering and retrieving information over the network. It uses existing Internet protocols and formats to tie into as broad a range of information as possible. It also provides capabilities for asynchronous collaboration based on this distributed model of information access and control, including support for document construction, modification, and annotation.

VROOM Applications

VROOM projects represent a variety of computational science and engineering applications:

Algorithms
Artificial life
Astrophysics
Atmospheric science
Biochemistry
Biomedicine
Collaborative networked visualization
Earth science
Engineering
Fluid mechanics
Fusion physics/energy research
Geometric modeling
Mathematics
Medical imaging
Molecular biology
Neuroscience
Oceanography
Performance analysis
Situational training

DETOUR: Brain Deconstruction Ahead



This autobiographical account by artist Rita Addison describes perceptual changes she experienced subsequent to her head injury in a car accident. DETOUR uses computer brain models and medical imaging to demonstrate anatomical trauma. In the final section, Addison's pre-accident photographic art is reconfigured to simulate the perceptual damage she sustained.

This virtual-reality experience is a powerful way to evoke and stretch empathic capabilities. Whether it is used in collaborative medical evaluations or to educate medical professionals, students, patients, and families, virtual-reality technology is a unique and invaluable tool for communication.

CATEGORY
Medical Imaging

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CAVE

ACKNOWLEDGEMENTS
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Interactive Molecular Modeling Using Real-Time Molecular Dynamics Simulations and Virtual Reality Computer Graphics

Using real-time interactive molecular modeling and molecular dynamics simulations, this project demonstrates the docking of a drug molecule to its molecular receptor. A molecular modeler guides a drug molecule into the active site of a protein, receiving real-time feedback from a molecular dynamics simulation running on an IBM SP-1 parallel computer. The molecular system is displayed and manipulated in the CAVE virtual-reality environment.

Using virtual reality, drug designers can interact visually, aurally, and (ultimately) tactilely with molecular models. This environment is enhanced via feedback and input into a simulation that represents the realistic atomic interaction between molecules. Accurate and efficient methods of investigating the recognition and binding of drugs to their biomolecular targets will significantly enhance the drug discovery process.

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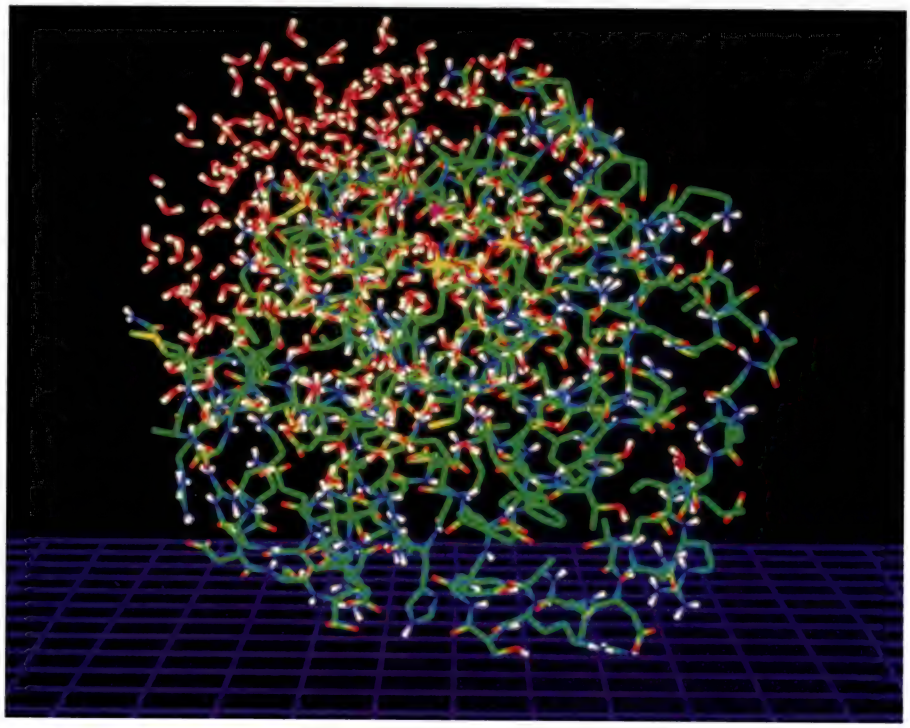

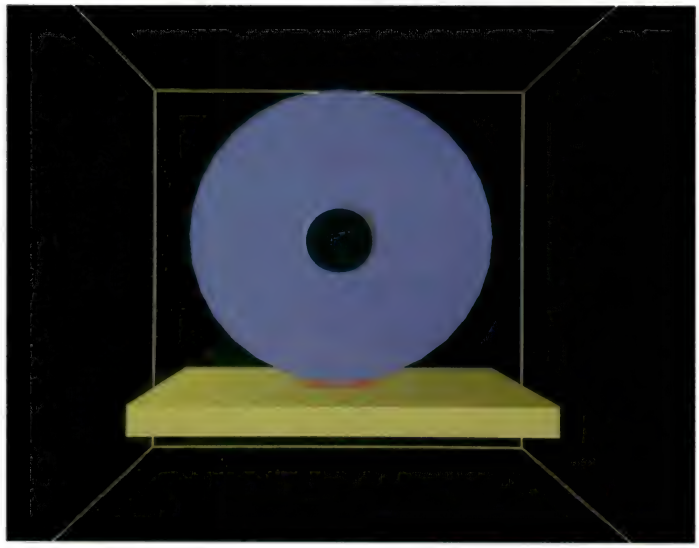

Simulation of a Grinding Process in Virtual Reality

Simulation of a grinding process in the CAVE enables users to explore a commonly used manufacturing process from an entirely new vantage point. An operator performs the simple task of grinding a component by controlling the motion of three axes of the table with the wand. When the wheel is in contact with a part on the table, heat is generated and material is ground away. This produces internal stress and heat flow in the part, wheel, and table. The temperature and stresses are computed in real time on an IBM SP-1 and selectively displayed on the various components as the simulation unfolds. Sound is generated by monitoring the surface motions predicted by the model. Materials ablated by the grinding are ejected as small particles and displayed as sparks.

Analysis of this simple manufacturing process involves solving complex equations at speeds that exceed the perceived event. Real-time interaction between an operator and a "virtual" machine provides new insight into how to interact with the real machine. It also enhances our ability to model physical processes and generate more realistic simulations.

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Interactive Adaptive Mesh Refinement

Adaptive mesh refinement/derefinement techniques have been shown to be very successful in reducing the computational and storage requirements for solving many partial differential equations. This project focuses on the Rivara bisection technique, which is suitable for use on unstructured triangular meshes such as those used in finite-element calculations.

Virtual reality demonstrates the realization of interactive adaptive mesh refinement. A user indicates the areas of the mesh to be refined using a 3D wand in the virtual space. This interaction is especially desirable in three dimensions, where users are immersed inside the mesh to locate interior regions that require refinement.

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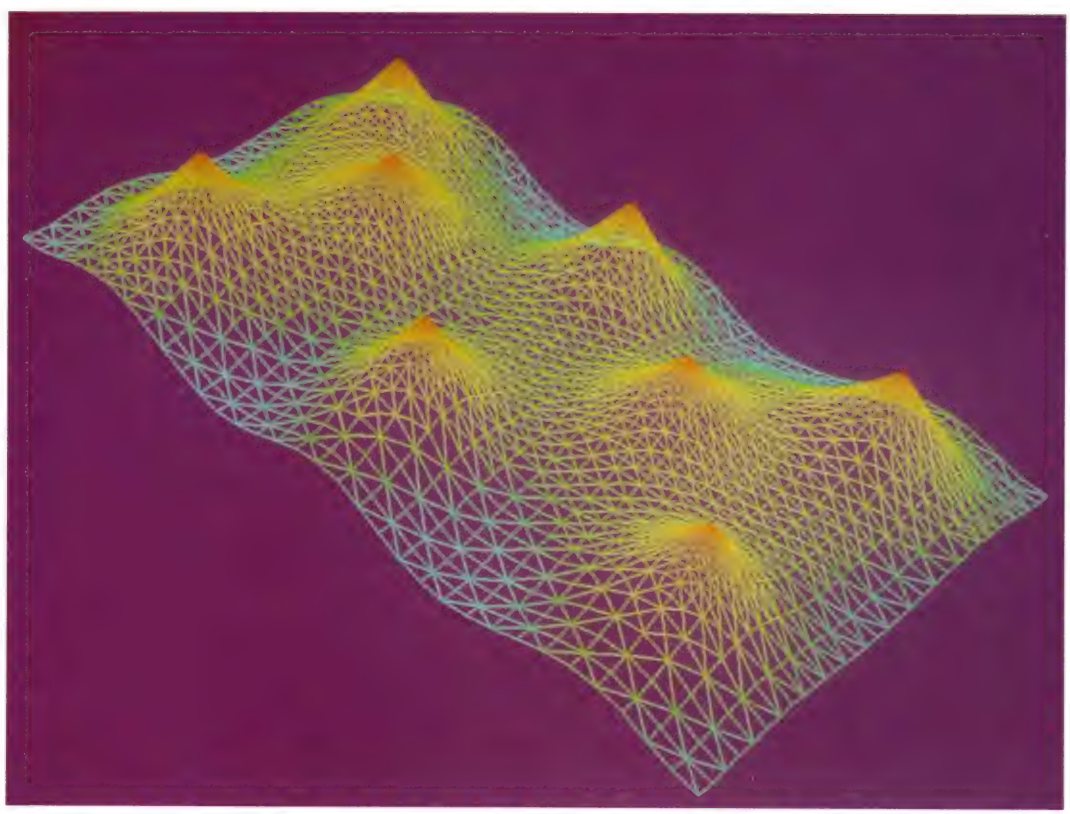

Visualization of Casting Process in Foundries

This application models the pouring of a fluidity spiral used to measure the distance metal can flow in a channel before being stopped by solidification. The gray iron at 1395 degrees C is poured into the mold for two seconds and flows down the spiral arm turning to mush at 1215 degrees C and solidifying at 1150 degrees C. The casting then continues to lose heat to the mold until solidification is complete.

The calculations were performed using the Casting Process Simulator (CaPS), robust multidimensional time-dependent computer code that uses a finite-volume formulation in solving mass, momentum, and energy equations, and performs mold filling and solidification.

CATEGORY
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ACKNOWLEDGEMENTS
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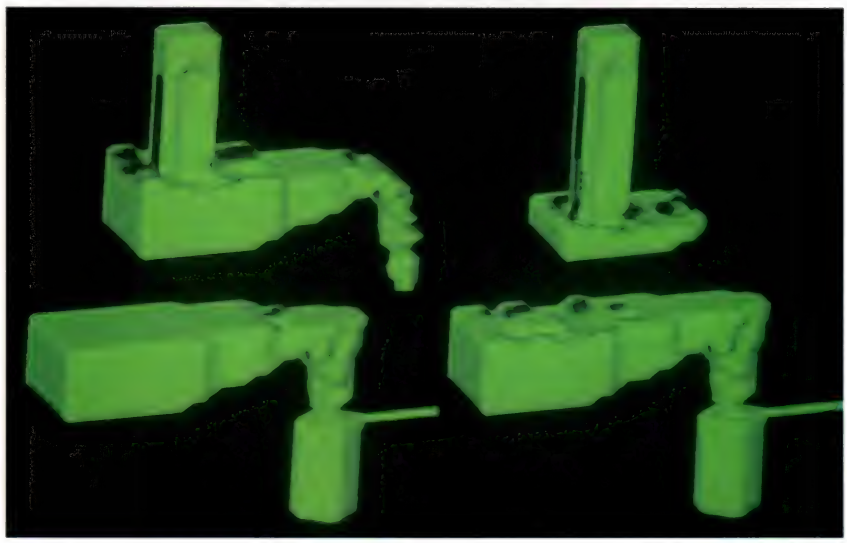

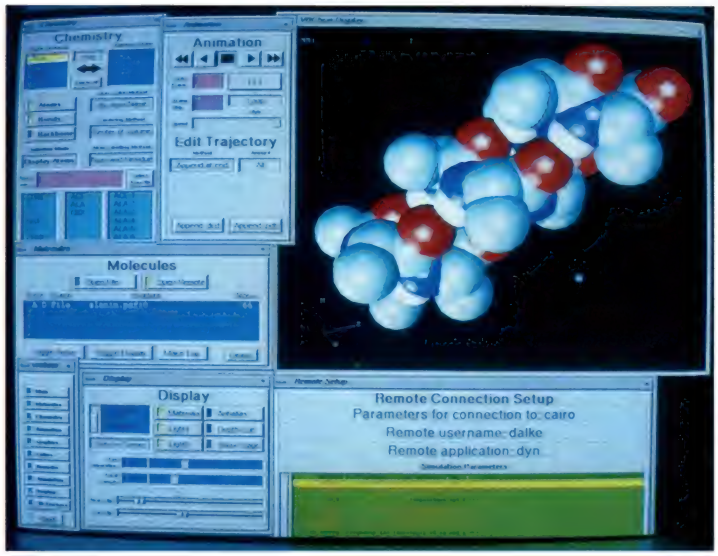

Distributed Interactive Molecular Dynamics

Starting with the experimentally determined atomic structure of a molecule, the force on each atom is computed, and then the motion of the whole molecule. These molecular dynamics simulations are used to explain reactions that are hard to investigate by other means.

As the power of computers has grown, the size of these simulations has increased, and the amount of information generated and required by them has become overwhelming. For example, a typical simulation may produce 500 megabytes of output. In order to make sense of this large amount of data, this project uses the extra information available in a 3D virtual presentation.

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EQUIPMENT
CAVE

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VRChem is an ongoing research project of the UIUC Resource for Concurrent Biological Computing in collaboration with the National Center for Supercomputing Applications. Initial design and development was done by Mike Krogh, Bill Humphrey, and Rick Kufrin; ongoing development is being done by Bill Humphrey, Andrew Dalke, and Rick Kufrin. RCBC is supported by the National Institutes of Health, grant P41RR05969. VRChem development is also partially supported within an HPCC grant from the National Science Foundation.

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RealEyes: A System for Visualizing Very Large Physical Structures

Both airplanes and space stations are extraordinarily complex systems. They each contain millions of parts. Determining how well large assemblies of parts will fit together (or how they won't) while they are still at the design stage is a very important task, because fixing these sorts of design problems after the parts are manufactured is far more difficult and expensive than fixing the problems at the design stage.

Boeing demonstrates some very large, complex CAD models of a Boeing 747 interior and Space Station Freedom. These models are taken directly from the design engineers, and each contains several million polygons (several orders of magnitude more than models displayed in other systems). They are quite detailed, right down to the airflow controls above each seat and the hot/cold labels on the water faucets.

This virtual reality system allows engineers to discover and analyze problems using much larger collections of CAD models than ever before. The navigation interface is easily learned by novices, and it is much more powerful in the hands of expert users than any screen-based interface known to the Boeing engineers who designed it.

CATEGORY
Engineering

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ACKNOWLEDGEMENTS
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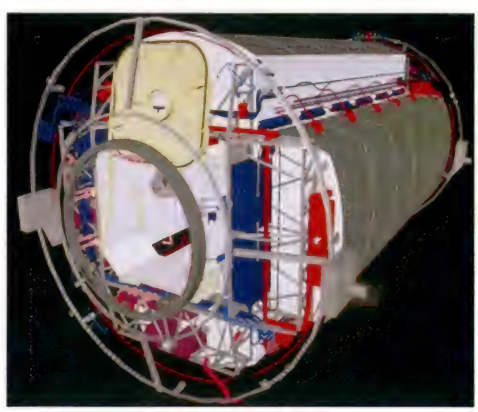

Phase and Amplitude Maps of the Electric Organ Discharge of the Weakly Electric Fish, Apteronotus Leptorhynchus (Brown Ghost)

This demonstration models the Apteronotus Leptorhynchus (commonly known as the Brown Ghost). It displays simulated data of the electric fields emitted by the fish, as well as how the fields are distorted by an object placed in the surrounding water.

The purpose of this fish simulation is to establish an understanding of how emissions are generated by the real fish. Since humans do not have an electric sense, it is difficult to comprehend how fish electric fields "feel". Alternative techniques, such as virtual reality, must be used to acquire some of that sensation. The results will help us understand how this fish uses phase and amplitude information from the electric organ discharge for electrolocation and communication.

CATEGORY
Neuroscience

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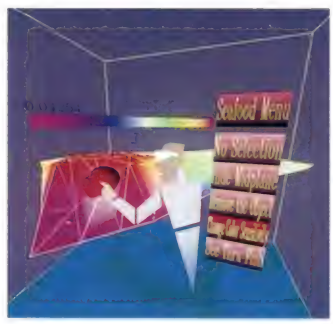
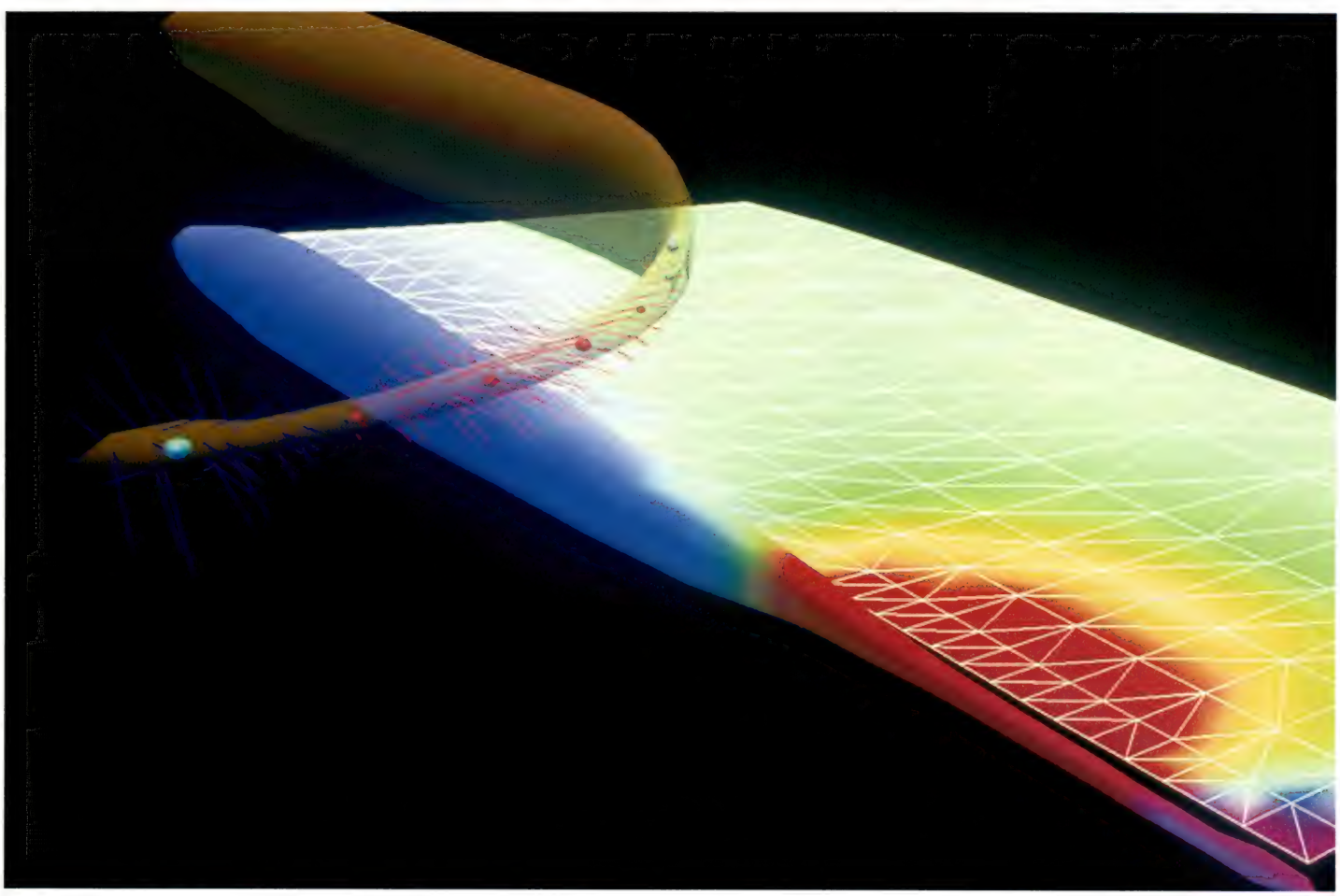
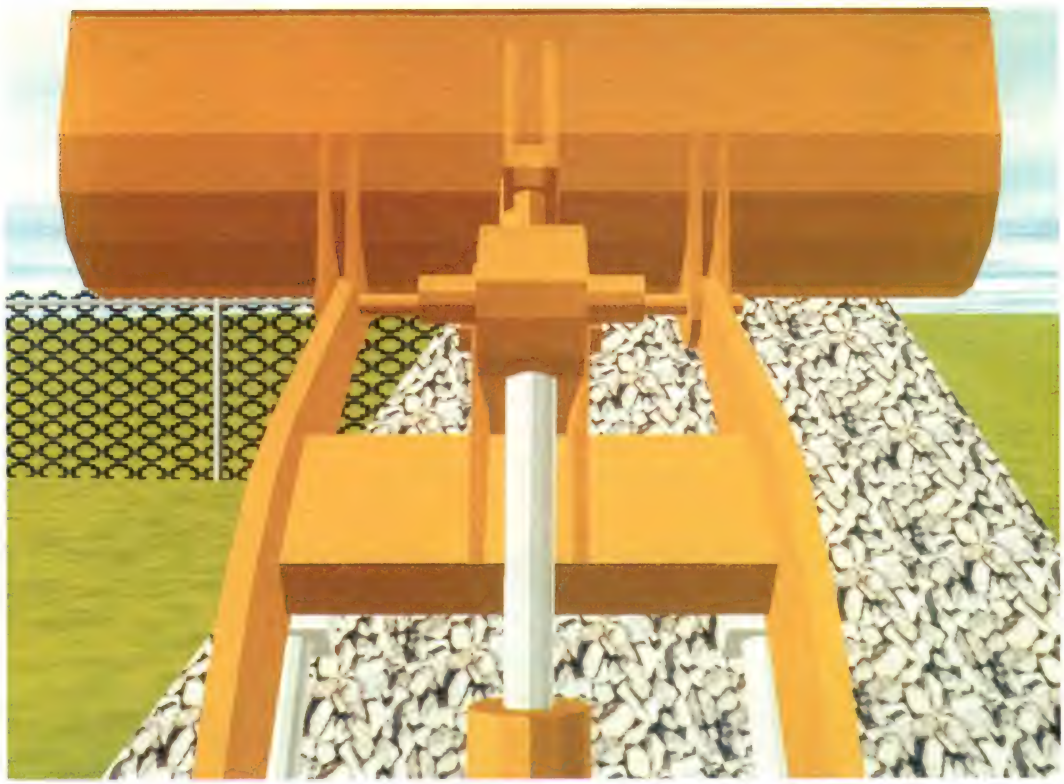




Using Virtual Reality for Machine Design

Caterpillar, Inc. uses virtual reality as a tool for interactively evaluating new machine designs. Using virtual reality, the operator of a virtual machine can test alternative machine designs while driving through a virtual proving ground, or can perform a loading cycle to fill a truck with soil. Hydraulically-actuated tools can be assessed with various hydraulic systems.

Using a virtual reality system enables engineers and designers to get a "feel" for their machine designs very early in the design stage. They can evaluate many different designs in less time than conventional methods require.



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Engineering

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Acetylcholinesterase: Nature's Vacuum Cleaner

This research focuses on the electrostatic forces generated by Acetylcholinesterase, an enzyme that plays a key role in the human nervous system. Neurotransmitter molecules (acetylcholine) are drawn down a long tunnel and into a "reactive-site" cavern deep within the enzyme where they are cleaved into component parts for reuse. By literally voyaging into the enzyme along a route similar to that taken by neurotransmitter molecules, researchers gain a unique vantage point from which to examine the electrostatic field and other computed probes of enzyme activity. An immersive display also is a unique medium for helping nonspecialists understand a sequence of chemical events that would otherwise be difficult to convey.

Improved understanding of the actual forces and dynamics at work in the acetylcholinesterase process should enable design of novel inhibitor molecules that have therapeutic value.

CATEGORY
Biochemistry

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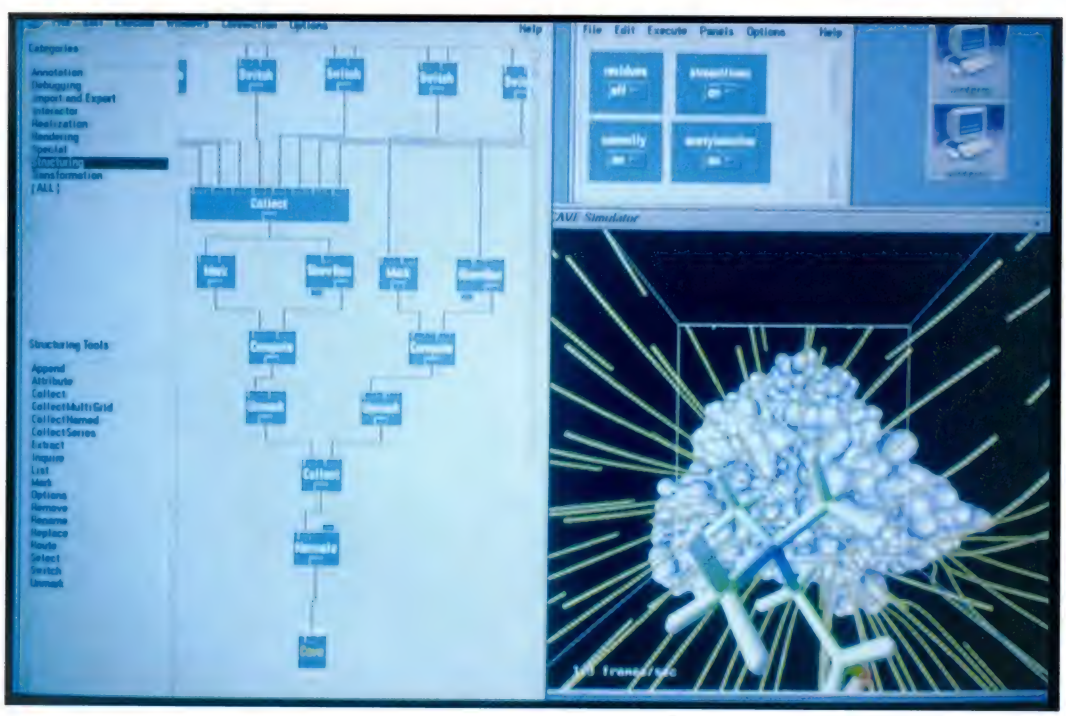

Visualization of Climate Data Over the Western United States

Many climatologists are interested in understanding energy transport in the atmosphere due to wind and precipitation. To achieve this goal, they must be able to observe anomalies and patterns, and they must be able to visualize cause-and-effect relationships implied by earth science data. Since these data either measure or simulate actual physical phenomena that humans sense in everyday life, it is natural to visualize this information in a way that emulates or complements our experience. A thesis currently being investigated is that immersion in a virtual world that models the one we live in may enable scientists to better understand the Earth's dynamic climatic processes.

This demonstration represents output from a regional climate model for the western United States. Data from the model are compared with actual measurements to help gauge the validity of the model.

CATEGORY
Earth Science

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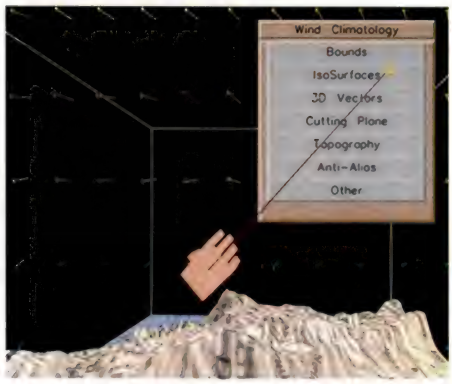

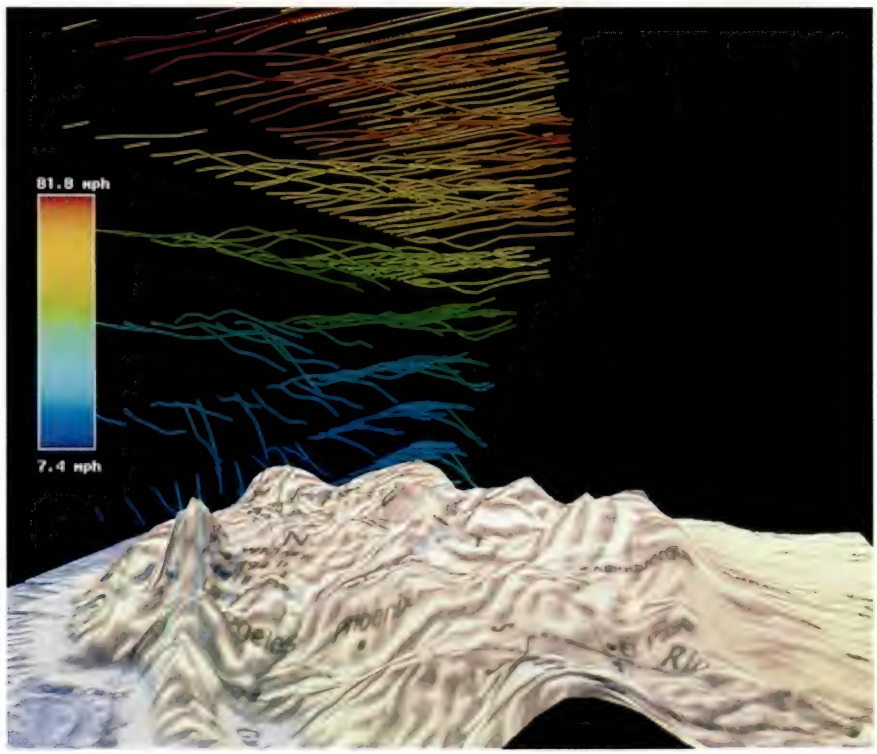

Simulation of Light and Sound Distribution in an Environment

One application of virtual reality is imitation of the real world. Using virtual reality, the optic and acoustic behaviors of an environment can be experienced directly, and modifications can be evaluated immediately. In this demonstration, light and sound distribution in different room types is simulated. Simulation parameters and room properties can be modified interactively, and the resulting optic and acoustic energy distributions can be visualized.

CATEGORY
Algorithms (lighting, acoustics)

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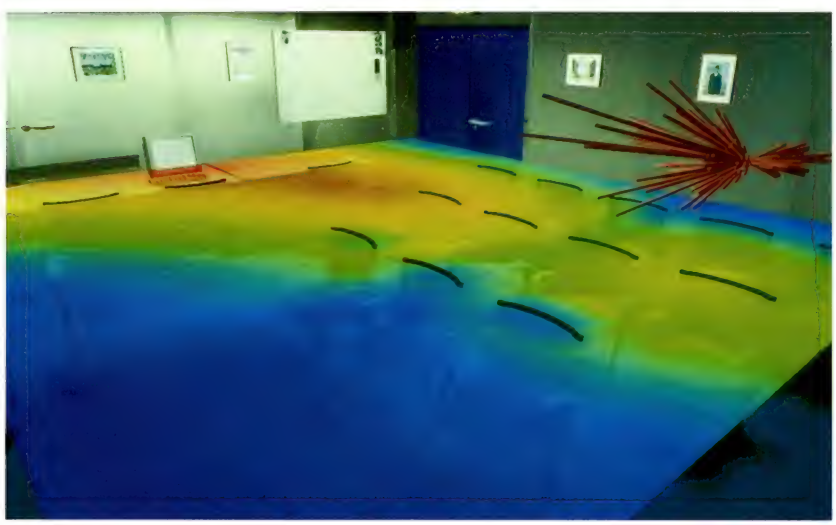

Knotted Spheres in the Fourth Dimension

Computer graphics simulations of virtual worlds help us develop intuition about objects we can never experience in real life. This demonstration exactly simulates interaction with images of complicated 4D structures as they would be experienced by an individual actually living in the fourth dimension and seeing with 4D light. The distinguishing feature of this virtual 4D world is that it produces holistic images that reveal global, rather than local, properties of the objects depicted.

Knotted Spheres in the Fourth Dimension exhibits real-time interaction with knotted spheres (knotted two-manifolds embedded in 4D space). A typical approach to visualizing such a surface is to project it into 3D and view it with 3D lighting, but this omits nearly all of the interesting 4D information about the structure. Instead, this system uses a fast approximation to volume-rendering volume images of projected 4D objects with true 4D lighting and occlusion, enabling viewers to interact with and pick out important mathematical features of this class of objects.

CATEGORY
Mathematics

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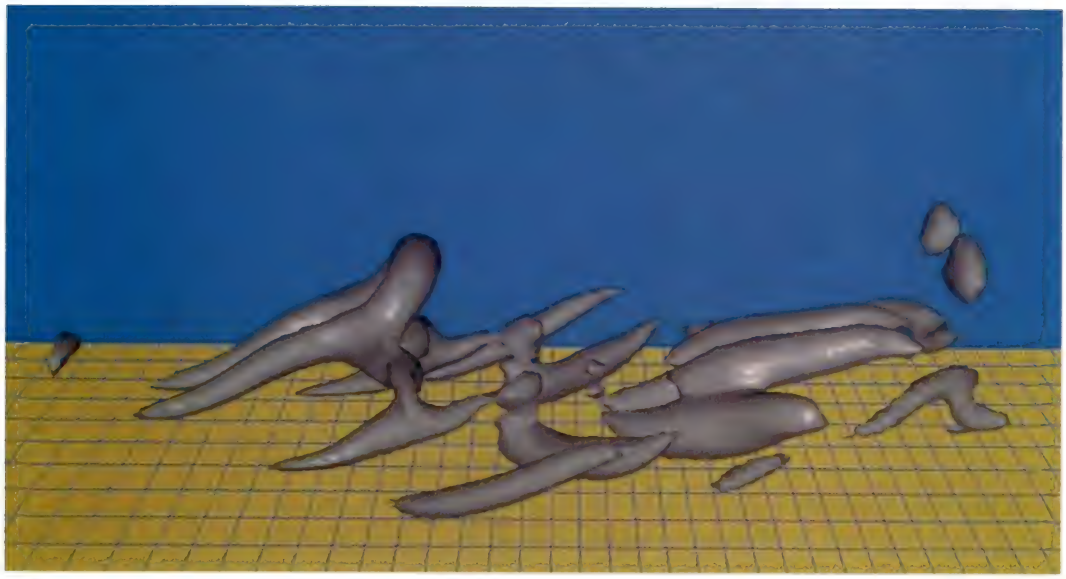

The Onset of Turbulence in a Shear Flow Over a Flat Plate

Smooth, laminar flow over a flat plate eventually becomes turbulent. The transition to turbulence generally occurs on a scale that is too small and too fast for an observer to appreciate in an empirical experiment. This application lets the user track the development of a turbulent spot (from a numerical simulation) at a size and speed that are comprehensible.

CATEGORY
Fluid Mechanics

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The Theoretical Flow Physics Branch at NASA Langley Research Center provided funding under contract number NAS1-19299. The direct numerical simulation was performed at the National Aerodynamic Simulation Facility. Thanks to Russell Taylor, University of North Carolina at Chapel Hill, for setting up the virtual reality facilities at ICASE.

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CitySpace

CitySpace is an educational networking project that invites students to build a virtual city model made up of 3D objects and images from sites around the world. The CitySpace project strives to present a learning model based on collaboration, simulation, visualization, and wide-area digital networking. The project is intended for integration into project-based curricula and is designed for self-managing groups of students, mentors, teachers, and resource administrators. The model relies on a flexible, open, high-speed network based on client-server technology, widespread access to desktop digital media production tools, and efficient utilization of high-end computational resources.

CATEGORY
Collaborative Networked Visualization

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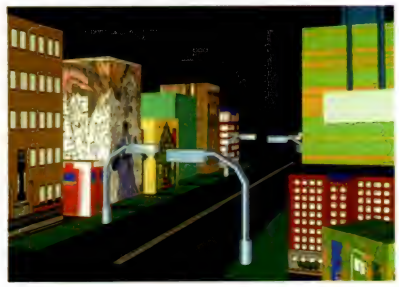

The Virtual Windtunnel

The Virtual Windtunnel is an application of virtual reality to the visualization of pre-computed simulations of air flow around aircraft. Through a natural 3D display and control interface, the Virtual Windtunnel provides a platform for intuitive and rapid investigation of complex airflows.

CATEGORY
Engineering

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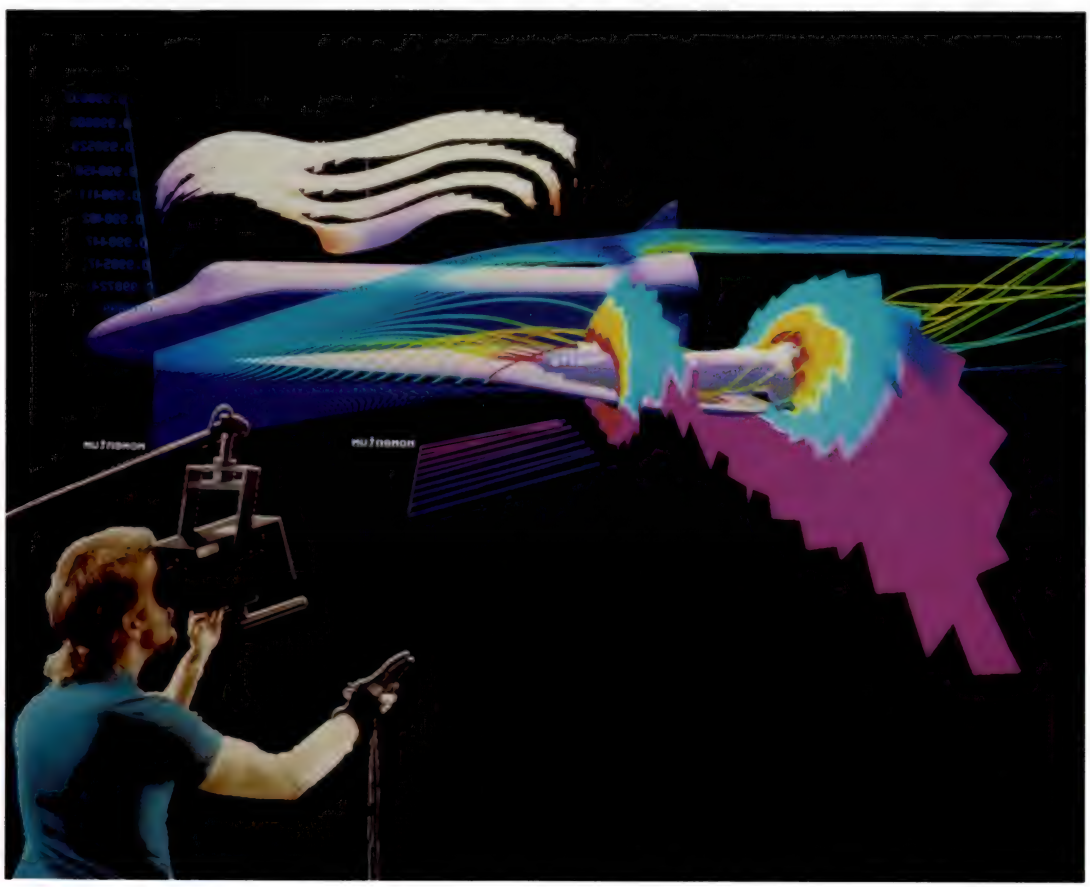

Three-Dimensional Terminal Viewer (3DTV)

Impaired visibility conditions caused by nightfall or precipitation can preclude aviation system users from obtaining the visual cues often helpful in detecting aviation weather hazards. Other aviation weather hazards cannot be detected by the naked eye. 3DTV was developed to study the value of real-time 3D visualization of derived weather hazards, such as microbursts, wind gust fronts, and heavy precipitation regions, to the aviation community. It provides a virtual environment that allows users to have a more intuitive understanding of the aviation weather hazard situation within the terminal area, and to promote effective communication between users through a shared and heightened situational awareness.

Algorithms, fed by real-time sensors such as Doppler weather radars, extract aviation weather hazards and allow the creation of a virtual world derived from physical phenomena. The system uses icons and surfaces to present an unobscured view of weather hazards to the target audience: air traffic managers, flow control specialists, and pilots.

CATEGORY
Atmospheric Science

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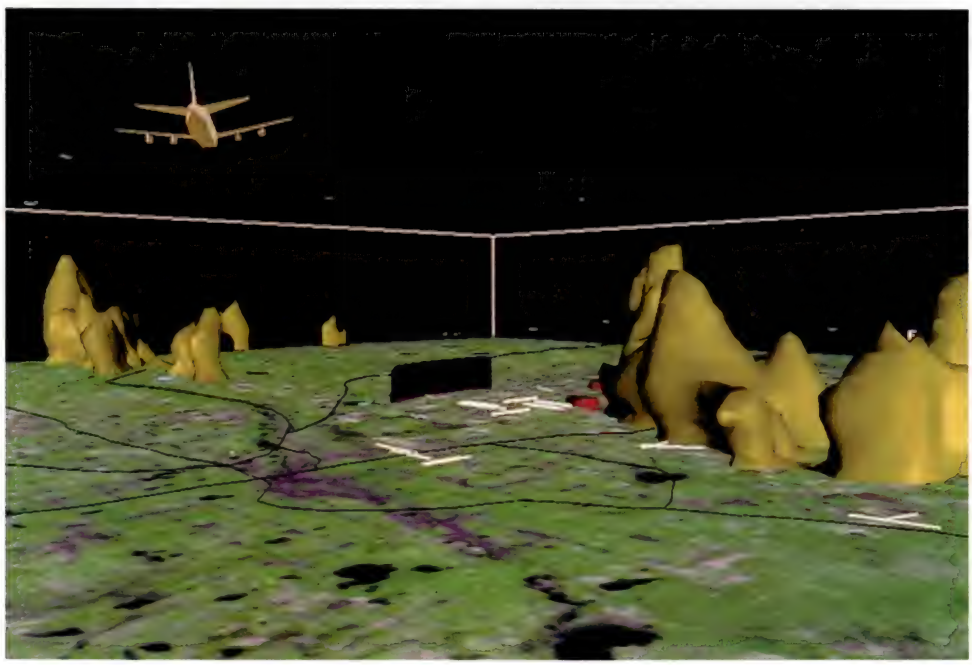
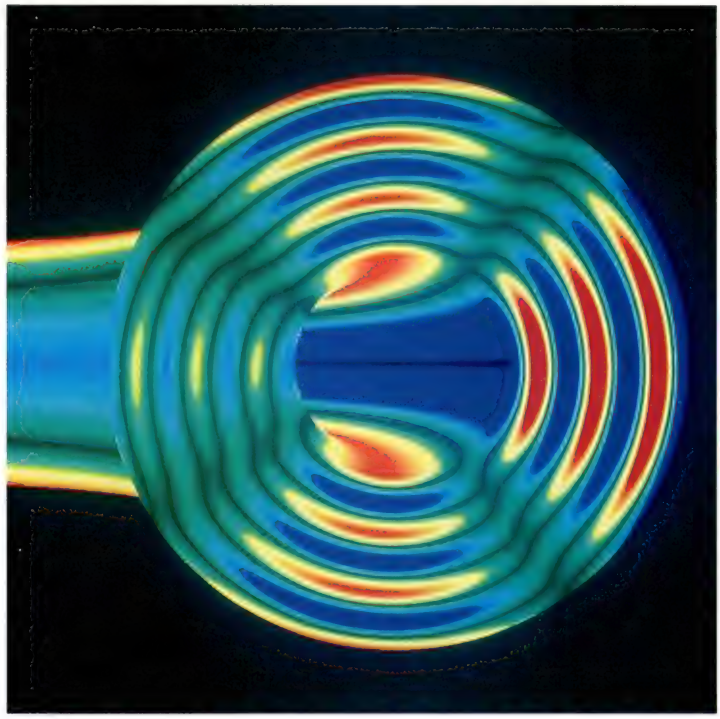


Scientific Visualization of Gyrofluid Tokamak Turbulence Simulation



High-performance algorithms for simulating and visualizing 3D plasma turbulence in magnetic fusion experiments have been developed as an aid in the development of more accurate predictive models of plasma transport and the design of future experiments. This work is part of the Numerical Tokamak Project, a national consortium of efforts using the most powerful supercomputers in the world to develop and use such numerical models. Virtual reality represents a "next step" in the development of a visualization system already in use by collaborators in the Numerical Tokamak Project.

CATEGORY
Fusion Physics/Energy Research

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Sounds from Chaos in Chua's Circuit

To exhibit chaotic behavior, an autonomous electronic circuit must contain at least one nonlinear element, one locally active resistor, and three energy storage elements. Chua's circuit is the simplest electronic circuit that contains these elements, and it is the only physical system for which the presence of chaos has been proven mathematically. It has become a paradigm for the study of chaos due to its universal chaotic properties, its simple circuit design, its ease of construction, and its rich variety of over 40 attractors.

Chua's circuit produces many types of signals, from sine-like periodic patterns to unpredictable noise-like patterns. These continuous signals can be generated in the human auditory range and displayed as sound using an amplifier and speakers or headphones. Sometimes, the sound resembles familiar musical tones. Other times, it produces novel sounds that contain both pitched and noise characteristics. By listening to the sound, observers can study fine details of a chaotic attractor. A composer could also organize the sounds into a musical presentation.

The unique aspect of the display of this study in virtual space is the simultaneous presentation of control space (manifold) and output phase space of the circuit. As users navigate the manifold surface, they receive immediate feedback by observing the phase display of the signal as well as changing acoustic responses.

CATEGORY
Algorithms (auditory display); Mathematics

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The Fluid Universe: Rayleigh-Taylor Instability in Fluid Flow

This interactive simulation of Rayleigh-Taylor instability shows what happens when a heavier fluid lies on top of a lighter fluid. The gravitational force causes the heavier liquid to form "fluid fingers" that flow down into the lighter liquid, causing mixing and turbulence. There are many astrophysical objects that show this kind of behavior, such as the remnants of giant explosions called supernova and the atmospheres of some stars.

Scientists viewing this application in the CAVE have achieved a better understanding of the texture (or morphology) of the data produced by the simulations. Specifically, the evolution of small eddies on the sides of the large Rayleigh-Taylor finger were very interesting to observe.

CATEGORY
Astrophysics

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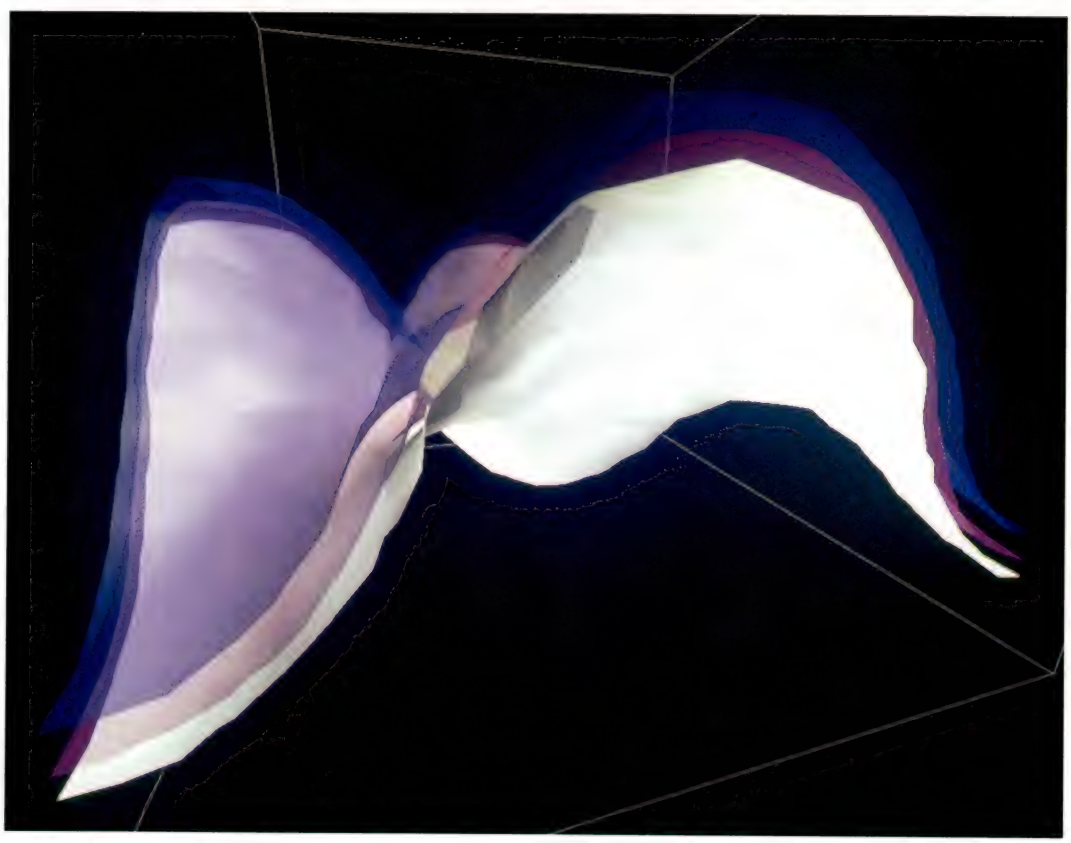

Post-Euclidean Walkabout

This real-time interactive CAVE application takes you on a visit to the post-Euclidean geometry of Gauss, Riemann, Klein, Poincare, and Thurston. Here you can walk into a rectangular dodecahedron, a shape which is possible only in negatively curved hyperbolic space. With a wand, you can summon and play with the snail-shaped 3D shadows of soap films in positively curved elliptic space. You can see how to sew the edges of hyperbolic octagons together into the surface of a 2-holed donut. The CAVE becomes a spaceship you can navigate with the wand, as it glides through the phantasmic shapes that populate the 3-sphere.

The purpose of this project is to perfect persuasive visual and sonic environments in which to exhibit geometrical wonders and their startling metamorphoses, which interest research geometers. Convincing visualizations of multi-dimensional, time-varying geometrical structures are equally useful in applied and pure mathematics.

CATEGORY
Mathematics

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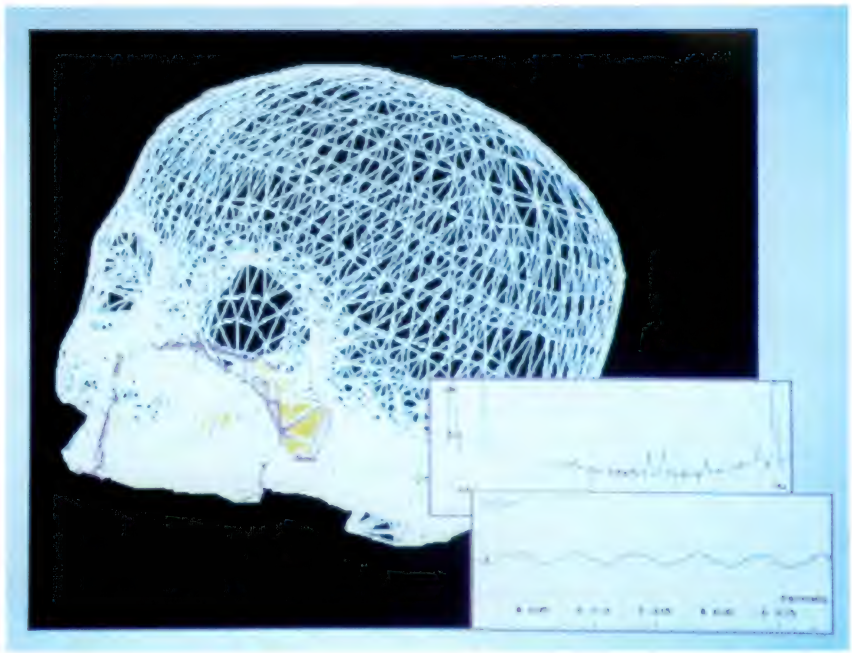
Stepping Into Alpha Shapes



A finite set of points in 3D space and a real-parameter *alpha* uniquely define a simplicial complex, consisting of vertices, edges, triangles, and tetrahedra embedded in space: the *alpha complex* of the points. The *alpha shape* is the geometric object defined as the union of the elements of the complex. By varying the values of alpha, the system can create crude or fine shapes – from convex hulls to detailed structures containing cavities that may join to form tunnels and voids. Several graphical interaction techniques, as well as the use of sound synthesis, enable users to explore alpha complexes with meaningful visual and auditory cues. Alpha shapes have application in geometric modeling, grid generation, protein structure analysis, and medical image analysis.

The alpha-shape software constructs a geometric object with detailed and possibly quite complicated features on the outside and inside. The CAVE enables the immersive visual inspection of features. The audio experience is made possible through real-time sound synthesis that reflects the detailed structure of the alpha shape.

CATEGORY
Geometric Modeling

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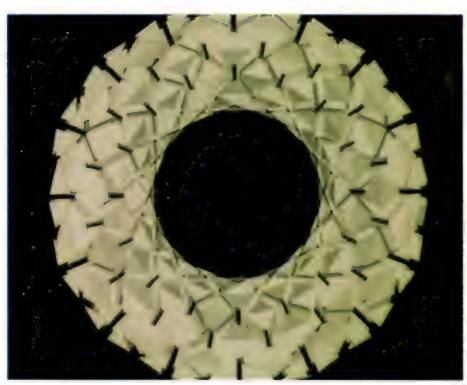

Virtual Breadcrumbs: A Tracking Tool for Biological Imaging

Virtual Breadcrumbs is an immersive virtual environment tool for tracking complex biological structures in a volumetric dataset. Through a combined volume and solid-model rendering visualization interface, it allows users to walk along the highly convoluted and twisted path of a fiber folding in three dimensions while simultaneously building a model of the fiber track. The tool is demonstrated with several medical and biological volumetric datasets. For example, it tracks chromatin fibers through the nucleus, cytoskeleton fibers through the cytoplasm, and neurons within brain slices from microscopic datasets.

The ability to track the structure of biological objects through a 3D volume is an important problem in biological and medical image analysis. It is also a difficult problem, because the need for continuous reorientation of the 3D viewing geometry causes spatial disorientation. The CAVE solves the problem and generates better tools for scientific investigation by providing a unique immersive environment for 3D biological image analysis.

CATEGORY
Medical Imaging

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ACKNOWLEDGEMENTS
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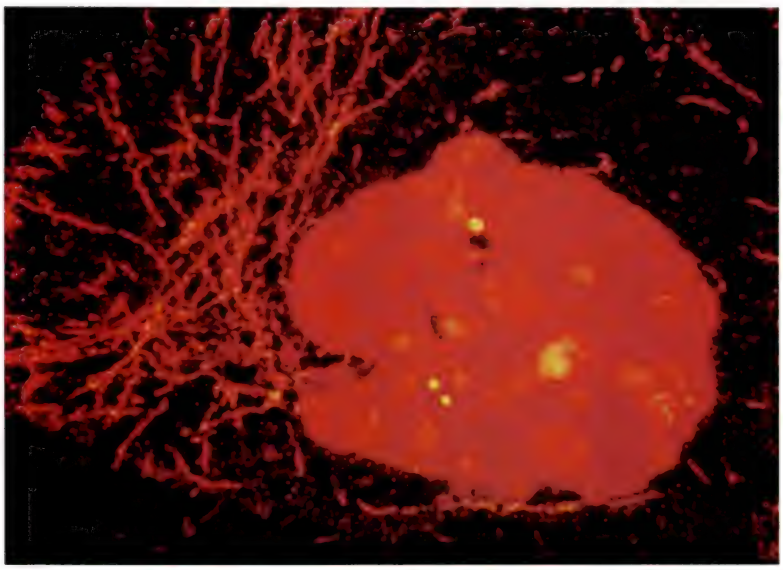
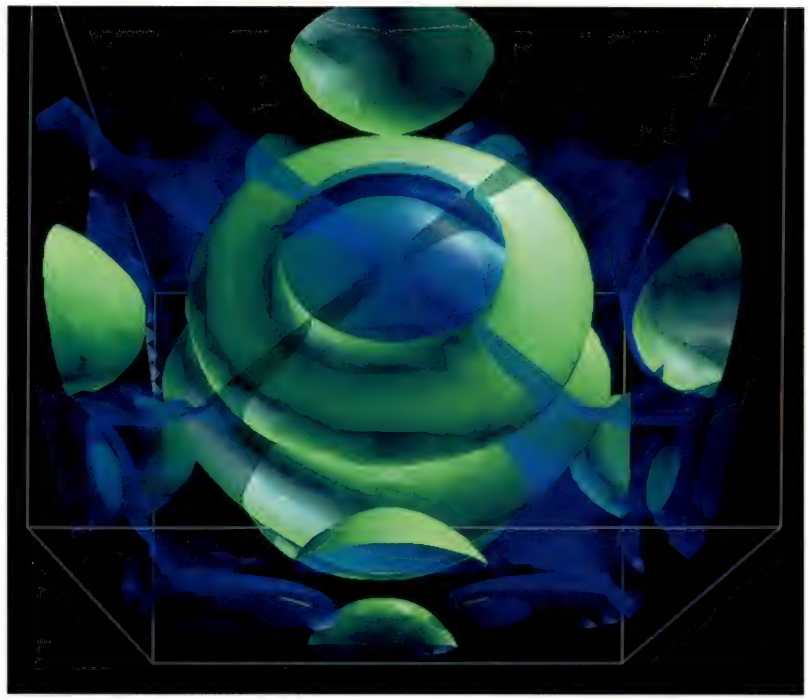


Spacetime Splashes: Catching the Wave of Einstein's Equations



Astrophysicists are interested in applying virtual reality and scientific visualization to spacetime simulations to help them better understand and interpret numerical studies of black holes, gravitational waves, and the Einstein equations for the gravitational field.

Einstein's theory of gravity, known as general relativity, is a complex set of nonlinear partial differential equations. In this project, full 3D codes have been developed to solve these equations for the gravitational field. The demonstration shows gravitational waves propagating through spacetime according to Einstein's equations for the gravitational field. The waves are disturbances in the gravitational field that travel at the speed of light. The simulation computes the evolution of various components of the waves.

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Astrophysics

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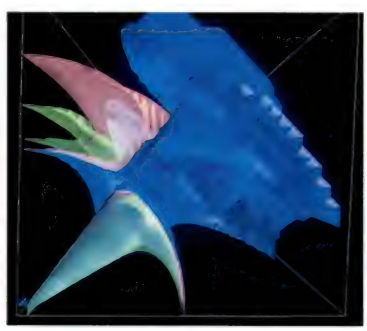

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Molecular Recognition in Protein-Protein Association

The phenomenon of macromolecular recognition is of immense interest in medicine and biotechnology. This process is studied in immune-system proteins in order to precisely delineate the nature of recognition between antibodies and antigens at various levels. In this demonstration, the steered encounter of an antibody is simulated using Brownian dynamics, and the trajectories are visualized in a virtual-reality environment to provide an intimate picture of interactions between the antibody and the protein.

CATEGORY
Biochemistry

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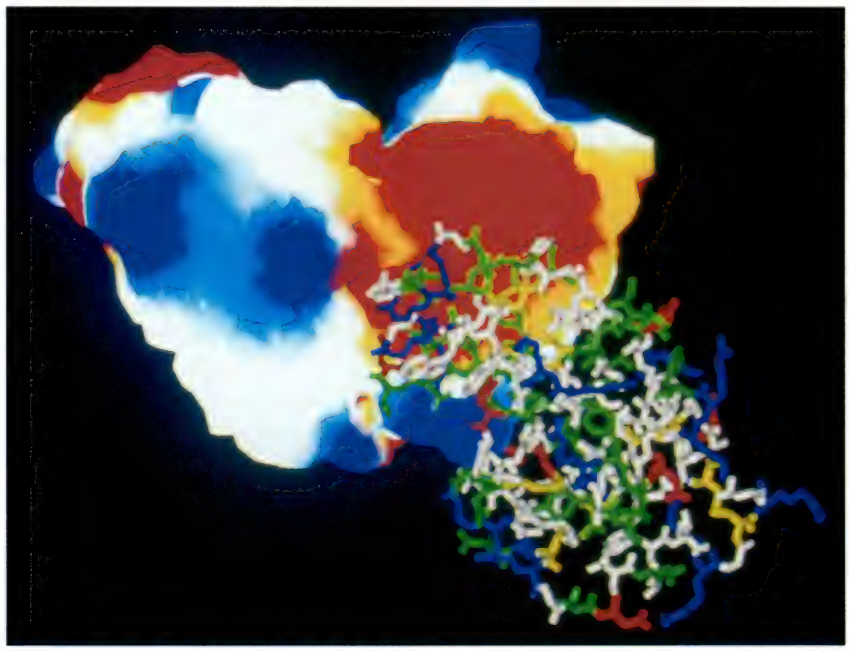

The Development of Tornadoes with Storms and Along Gust Fronts

This demonstration is derived from current investigations of the processes involved in tornado genesis along thunderstorm outflow boundaries. The massively parallel CM-5 and CM-2 supercomputers are being used to numerically simulate the local environments that support these tornadoes. Rendered isosurfaces, such as temperature surfaces, give a tangible representation of the outflow leading-edge structure and key instabilities that may be present. Trajectories launched near these instabilities yield valuable information about the flow regime present at the outflow leading edge.

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Atmospheric Science

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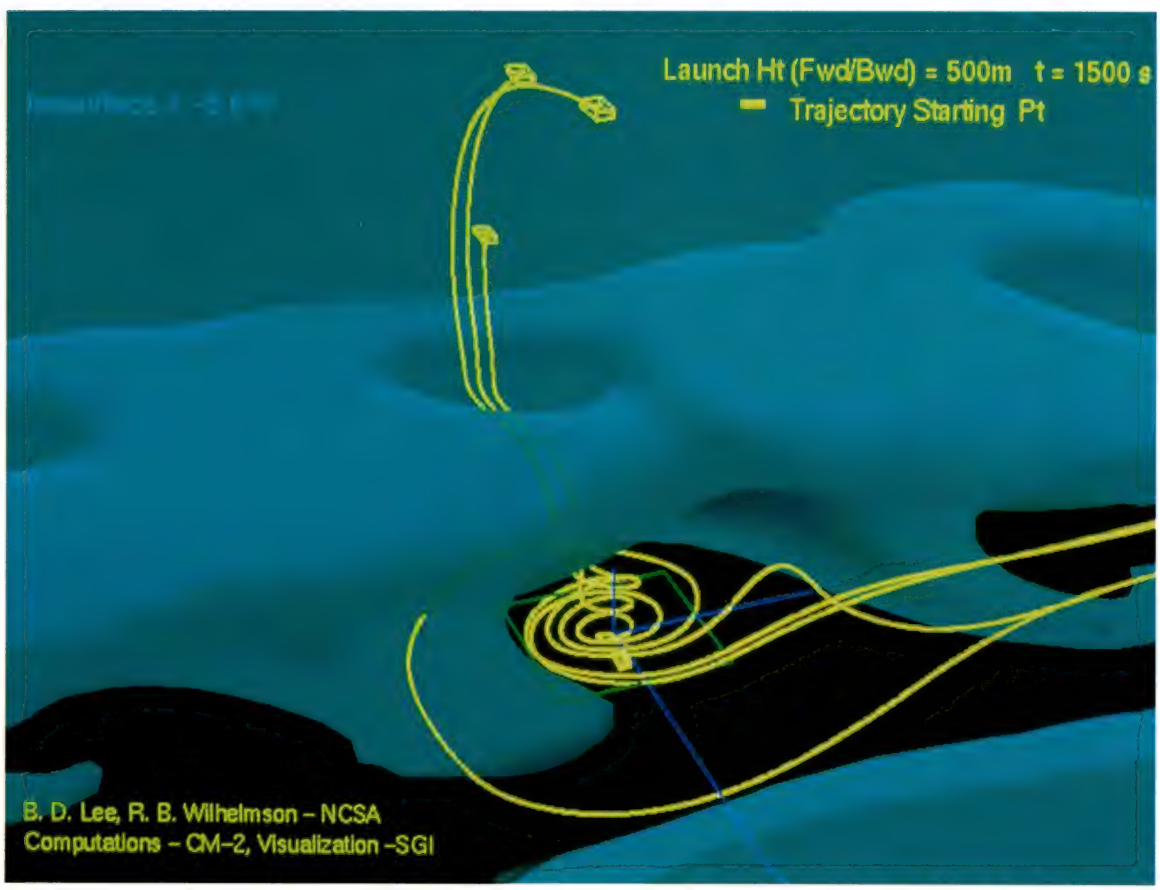

A Walk Through Chesapeake Bay

Unlike the atmosphere, the world's oceans are opaque, and processes that occur beneath the sea surface cannot be directly viewed. What little we see is inferred from measurements made with remote sensing instruments. Though it can be useful, this approach limits the ability of scientists (and the general public) to experience the many and varied processes that occur in marine environments. Now, with recent advances in computing and visualization, individuals can experience the environment beneath the sea surface in a visualization framework that is familiar to them. A visualization approach also allows many processes to be integrated, so that interaction of complex oceanic systems can be demonstrated (e.g., circulation and ecosystem dynamics).

Freshwater input is a primary forcing function for the circulation of estuarine systems such as the Chesapeake Bay. This first effort to focus on visualizing the input of freshwater to Chesapeake Bay allows the study of the effects of the Susquehanna, Potomac, and James Rivers, among others, on the salinity and hence the density structure of the Bay in a 3D time-dependent framework. This study combines bottom bathymetry, river discharge, hydrographic (temperature and salinity) datasets, and tidal datasets for the Chesapeake Bay, as well as circulation distributions from a numerical circulation model constructed for the Bay.

CATEGORY
Oceanography

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3D Hydrodynamic Model of the Heart

This computational model of the heart treats the heart wall as a set of fibers immersed in fluid and responding to both fluid forces and tension forces. The fluid, in turn, experiences a force field in the neighborhood of the fibers that prevents flow through the gaps in the fiber network, allowing the heart to pump the fluid. The anatomy modeled is that of a hog heart, for comparison with experimental data.

The main goal of this virtual-reality project is investigational. The hope is that it will help clarify the relevance of virtual reality to this type of study.

CATEGORY
Biomedicine

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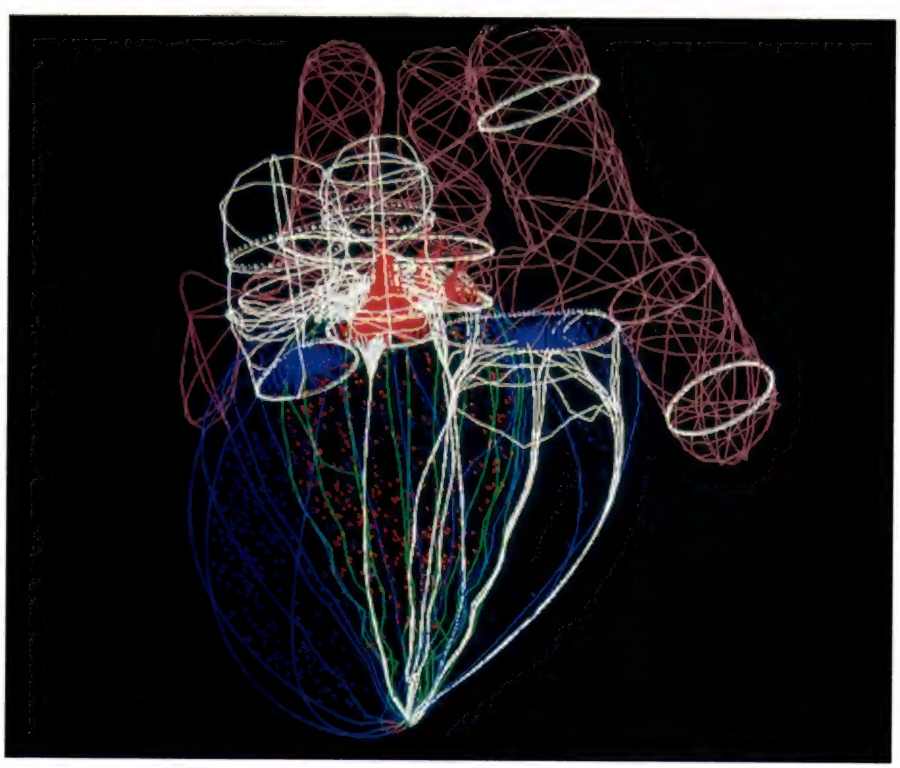
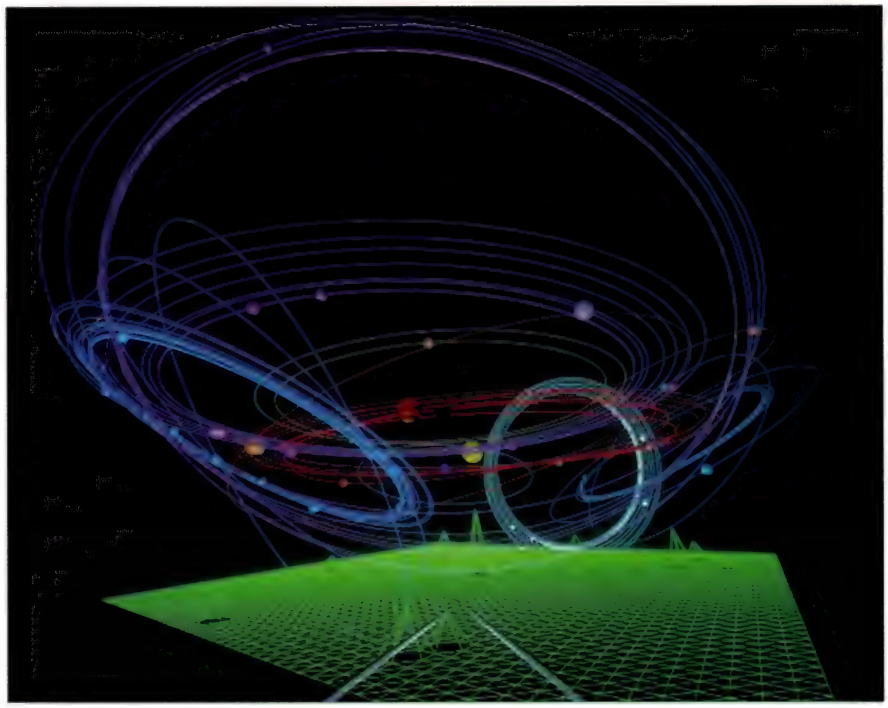


MUSE: Multi-Dimensional, User-Oriented, Synthetic Environment



MUSE is an open-software environment that provides a new approach to the human-computer interface. Using functional models of human interaction and physical device classes, it permits real-time mapping of user control onto application/system functions (input), and mapping of computer information onto different types of output devices. It is device-independent and handles different types of displays (from flat-screen to head-tracked stereo displays), voice recognition, speech synthesis, sound generation, and a variety of analog input devices. It supports simultaneously shared, networked environments and provides a versatile craft model with control, navigation, manipulation, and display capability to facilitate exploration and analysis of complex information spaces.

VROOM showcases a number of scientific and engineering applications that use MUSE, including: volumetric CT scan data; a modular analog controller (fusing approximately 36 different types of time-dependent information, from finite-element thermal analysis to electrical circuit simulation, into visual, auditory and craft displays); explosive welding (using an explosive charge to instantly weld a copper pipe to a beveled steel plate and to deform the pipe to match the bevel); and a simulation of the solar system in logarithmic scale that covers a spatial range of 10^{10} kilometers, with a dynamic positioning resolution of approximately 25 kilometers.

CATEGORY
Algorithms (human/computer interface); Engineering; Scientific

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Real-Time Graphics Techniques Using IRIS Performer

Whether used as a training simulator or as an architectural design tool, most visual simulations try to achieve a sense of immersion for better usability and enhanced training value.

These virtual environments demonstrate various techniques in real-time computer graphics using IRIS Performer, a performance-oriented, multiprocessing 3D graphics toolkit. The techniques include level-of-detail control for frame-rate constancy, view culling, texture mapping, detail texturing, pre-computed animation sequences, billboard polygons, and morphing. The scenarios include a drive through a town, a walk through a radiosity-solved architectural model, and a demonstration of real-time shadow generation using projected texturing.

CATEGORY
Algorithms

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ACKNOWLEDGEMENTS
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Virtual Exploration of a Florida Thunderstorm Using the SciAn Visualization Package

Raw and analyzed data from a variety of sources, as well as simulation, are used to explore a storm system in central Florida. The purpose of this research is to better understand the relationships among the co-evolving wind, water, and electric fields, with the goal of improving numeric models of storm systems and improving forecasts of precipitation, lightning, tornadoes, and downbursts.

Exploring the data in a virtual environment gives a better overall understanding of the structure of the storm than is possible with static or animated images on a flat screen. The ability to interact with the data in an inherently 3D space allows more natural exploration of the properties of the data. Merging an immersive environment with natural 3D interaction allows conventional visualization techniques, such as isosurfaces and streamlines, to function as extensions of the user's hands and senses.

CATEGORY
Atmospheric Science

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Stepping Into Reality

This team's current work is focused on embedding real (stair stepper) and computer-generated forces (mechanized and infantry) into a distributed interactive simulation. A virtual environment version of this work produced through stealth imaging is portrayed using the CAVE environment. An individual on the stair stepper can view the virtual environment, move around in it, and interact with other simulation entities by firing a weapon. As a feedback mechanism from the virtual terrain, the stair stepper provides a closer sense of reality.

CATEGORY
Situational Training

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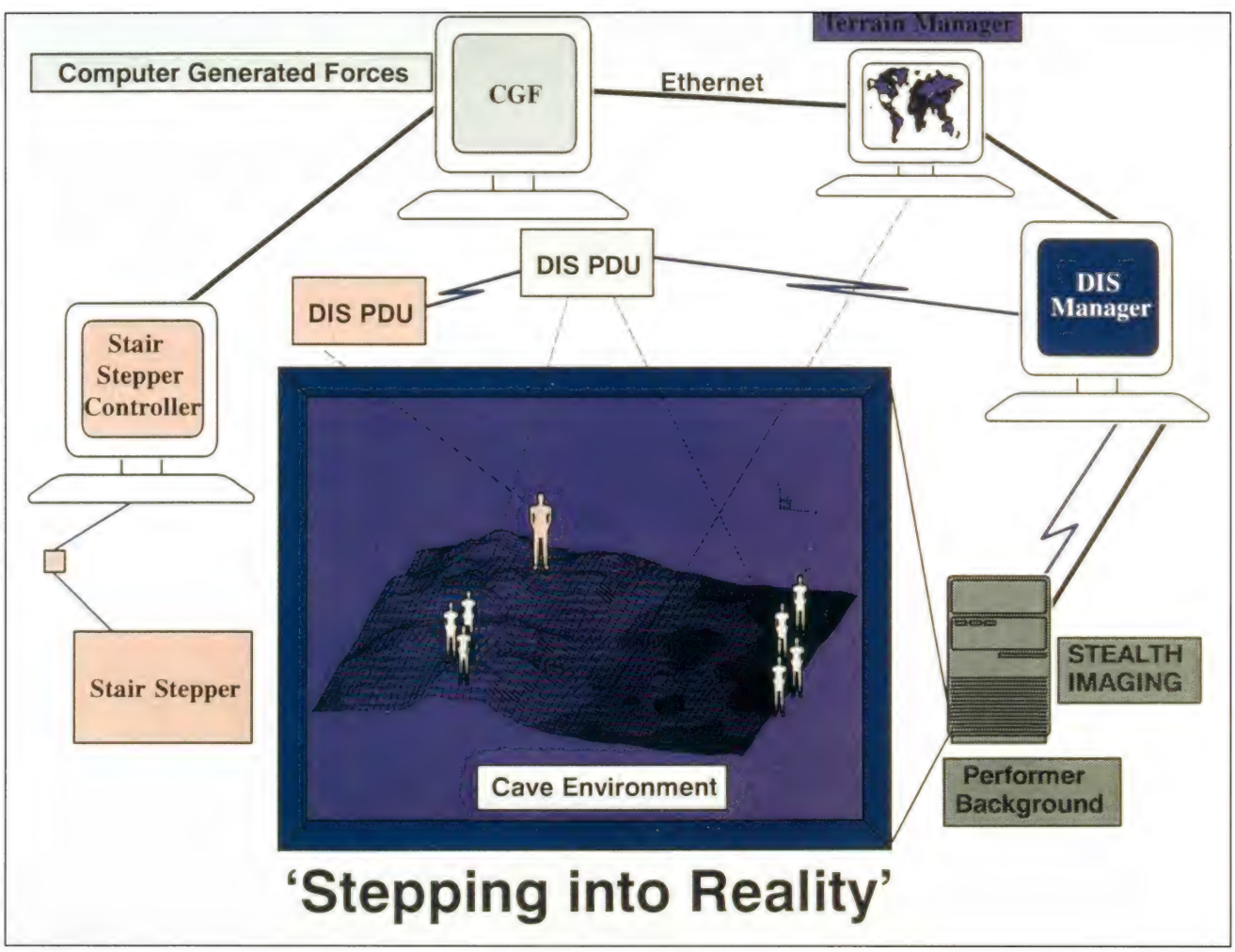

Parallel Real-Time Radiosity

This application demonstrates how parallel architectures are being used to render scenes in real time or close-to-real-time using physically based lighting models (in particular, radiosity). For VROOM, the application visualizes Argonne West's Breeder Reactor model database and other interior room scenes.

Virtual reality is helping to determine which components of global illumination models are important to provide users with a level of realism beyond standard lighting models. Implementing the algorithms for radiosity and other physically based techniques in virtual reality helps focus the work on the areas that are most in need of improvement – for example, performance enhancements using parallel architectures, better modeling of the physics of light transport, human perception issues, and other areas.

CATEGORY
Algorithms

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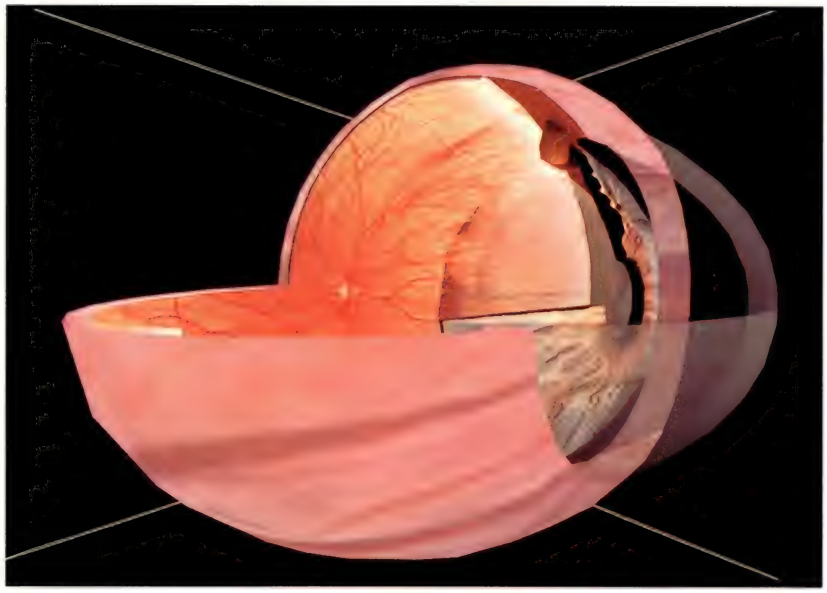
The Virtual Eye



This project demonstrates the design of an anatomically realistic computer model of a human eye in a virtual environment. Users are able to explore and interact with the eye's components to discover their characteristics. The model will eventually be used to educate students on the eye's geometry and will allow them to simulate common presurgical procedures.

CATEGORY
Medical Imaging

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JASON Interactive Mapper

The JASON is an underwater remotely operated vehicle operated by the Woods Hole Oceanographic Institute. This virtual-reality demonstration re-enacts the exploration of hydrothermal vents in the Guaymas Basin near Baja California. CAVE participants watch the JASON as it collects bathymetry data, temperature data, and high-resolution still images, and transmits a "live feed" from its video cameras (pre-recorded, in this case, for presentation purposes).

With a virtual-reality interface, users are able to visit this normally inaccessible region via telepresence. After they watch the JASON explore the vents, users construct a 3D map from what they have seen, physically placing icons that represent observed objects and events into the virtual environment.

CATEGORY
Oceanography

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Evolution of Behavior in a Simulated Environment

This application enables CAVE users to view and interact with the behavior of various animats, virtual animals that exhibit behaviors similar to those of natural animals, such as predators, scavengers, or gatherers. The user interacts with the animats by giving distinct behaviors rewards or penalties that affect the life of the animat and its future generations. The fundamental notion of the application is based on the field of Artificial Life, the study of living organisms through artificial means.

Virtual reality enhances this simulation by providing users with immediate feedback on various behaviors. Behaviors should be easily recognizable and users should be able to determine if the behaviors are similar to what is expected. The visual feedback is different from traditional text-based results.

CATEGORY
Artificial Life

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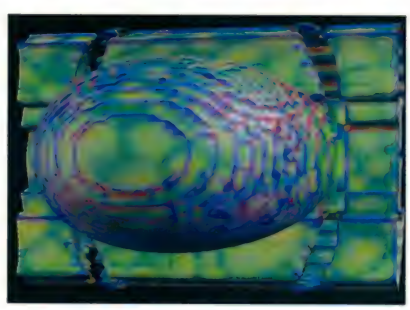
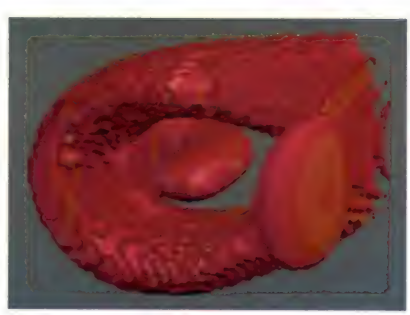
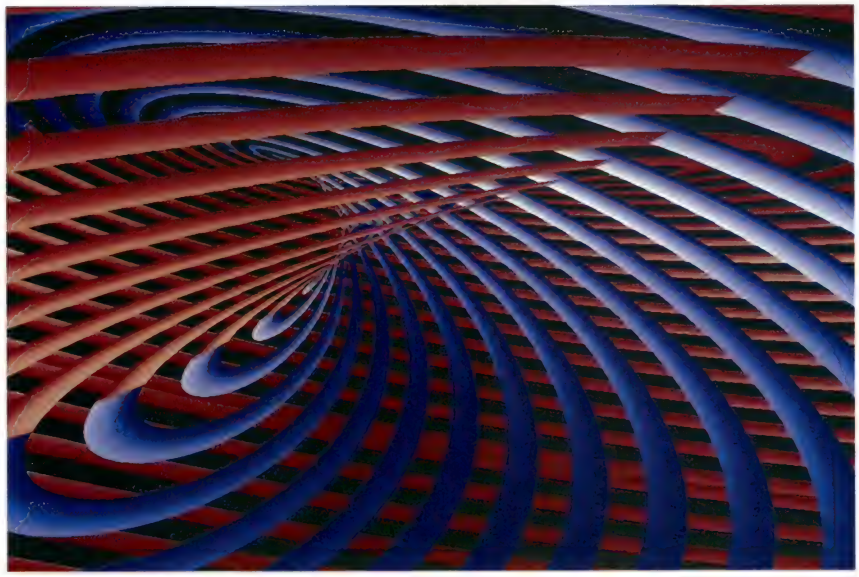




Getting Physical in Four Dimensions



The goal of this application is to provide a more intuitive understanding of hyperspace. It enables users to physically interact with objects in four dimensions.

A series of classical 4D objects is projected into the 3D CAVE through simultaneous projection of both 3D slices and perspective projection. There is also a mode that enables the user to directly draw 4D surfaces of revolution by drawing a 3D curve. The user controls both the 4D projection point and the 3D viewing point, in addition to rotation and translation, in four dimensions.

A sub-cultural goal of this project is to enable users to develop an intuitive understanding of hyperdimensional worlds. Human beings have learned about the 3D world in which we live by manipulating objects within it. In this project, the goal is to let people directly manipulate 4D objects in four dimensions. Previously, 4D objects were projected into three dimensions and then into two dimensions for viewing. Virtual reality allows a much more 3D environment, minimizing the effects of 3D-to-2D projections. It also creates a more physical interface to the 4D objects and their projections and transformations, which gives participants better intuitive insight into four dimensions.

CATEGORY
Mathematics

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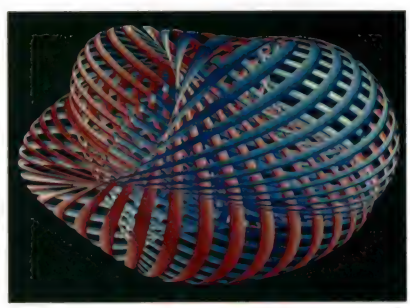

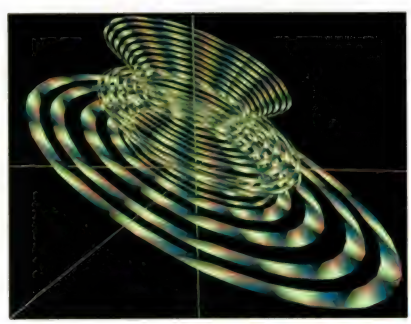

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Virtual Director

Virtual Director provides a user-friendly, virtual-reality method to control camera motion for instant playback or animation recording. The Virtual Director shown in VROOM is a camera motion-control application using the CAVE to control and play back users' input in real time. Stored camera-motion data can be used to control various computer-generated imagery cameras (e.g., Wavefront, AVS, Renderman, etc.). This demonstration also includes an astronomical simulation of colliding galaxies that has been fully rendered in batch mode with this kind of camera motion control in mind. The galactic data were simulated using a supercomputer and visualized with Wavefront.

Historically, controlling camera motion has been one of the most clumsy aspects of computer animation. When camera motion is recorded and played back using virtual reality, the control mechanism is much more user-friendly and natural for novice users than attempting camera control with traditional methods. Virtual reality facilitates the real-time interface for camera motion viewing, recording, and playback. This application is robust and can be applied to various 3D imaging settings as well as scientific datasets.

CATEGORY
Algorithms (animation production and recording)

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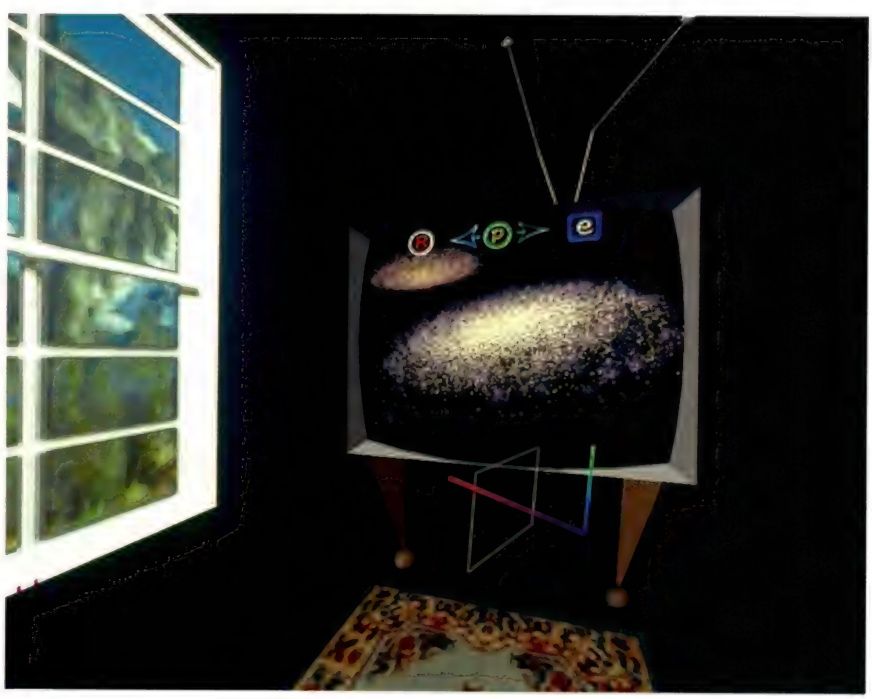

Topological Surface Deformation

The CAVE's immersive virtual environment enables participants to walk around mathematical shapes, step through complex surfaces, or move a surface through itself. Virtual reality encourages users to see shapes from a new perspective – from the inside, looking out – and to explore and manipulate complex surfaces in order to better understand them.

Topology is the study of the characteristics of mathematical surfaces, such as their number of sides, edges, or holes. This program uses free-form deformations to study the topology of mathematical surfaces. Deforming a surface changes its shape, but not its characteristics; an edge remains an edge, and a hole remains a hole, no matter how distorted the edge or hole appears. The claim of topologists that a donut (torus) and a coffee cup are topologically equivalent is one of the deformations demonstrated in this program.

CATEGORY
Mathematics

COLLABORATORS
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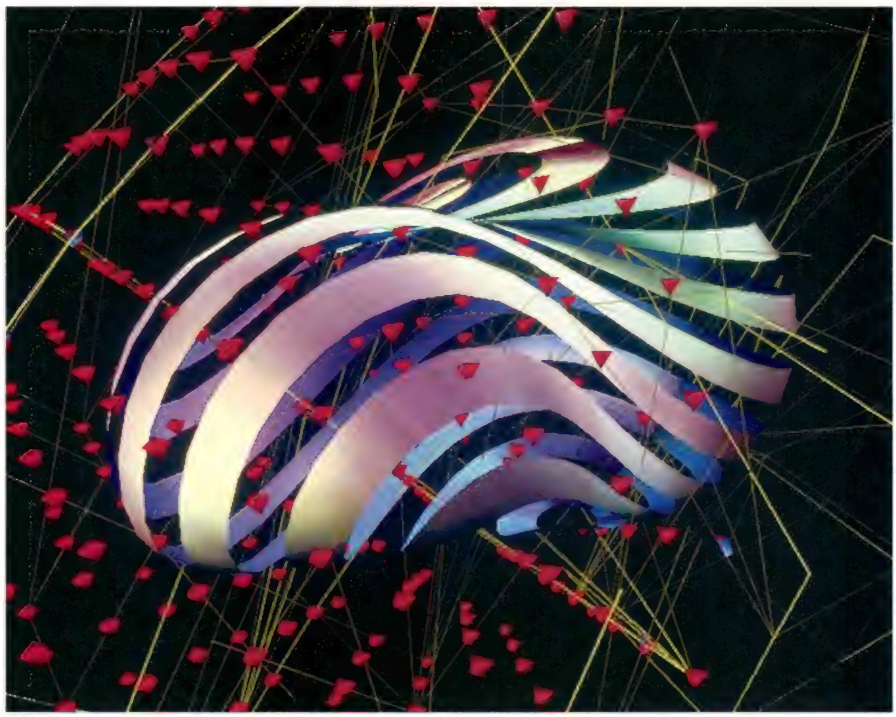
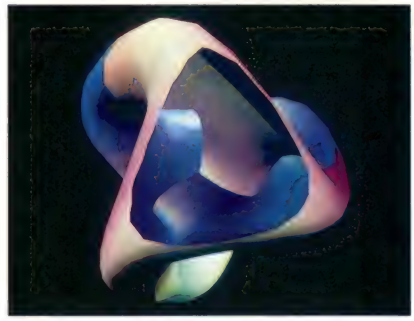
EQUIPMENT
CAVE



ACKNOWLEDGEMENTS
This work is supported in part by National Science Foundation grant IRI-9213822 and grant CDA-9303433, which includes support from the Advanced Research Projects Agency. Special thanks to Jeff Terstriep of the National Center for Supercomputing Applications.



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Virtual Reality for Parallel Computer System Performance Analysis

Recording and analyzing the dynamics of application programs, system software, and hardware interactions are the keys to understanding and tuning the performance of massively parallel systems. Because massively parallel systems contain hundreds or thousands of processors, each potentially with 5-10 dynamic performance metrics drawn from multiple system levels, the performance data occupy a very sparsely populated, high-dimensional space. Understanding the dynamic "shape" of multiple performance data metrics in a high-dimensional space is only possible if one can examine multiple projections of this space.

The ultimate goal of this performance data immersion project is performance optimization and control of massively parallel systems. Not only does data immersion allow one to quickly grasp the relationships among large numbers of performance metrics, but by causally tying a metaphor in the virtual environment to a performance data source in the system or application code, it also allows the observer to intuitively realize real-time, adaptive control of system or application performance.

CATEGORY
Performance Analysis

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This work is supported in part by the National Science Foundation under grants IRI-92-12976 and CDA-87-22836, by the National Aeronautics and Space Administration under NASA Contract Number NAG-1-613, by the Advanced Research Projects Agency under ARPA Contract Number DAVT 63-91-C-0029, and by a collaborative research agreement with the Intel Supercomputer Systems Division. Special thanks to Phil Roth for developing the sliding window average code, to Tara Madhyastha for the sonification software, and to Roger Noe and Jay Huber for the application instrumentation.

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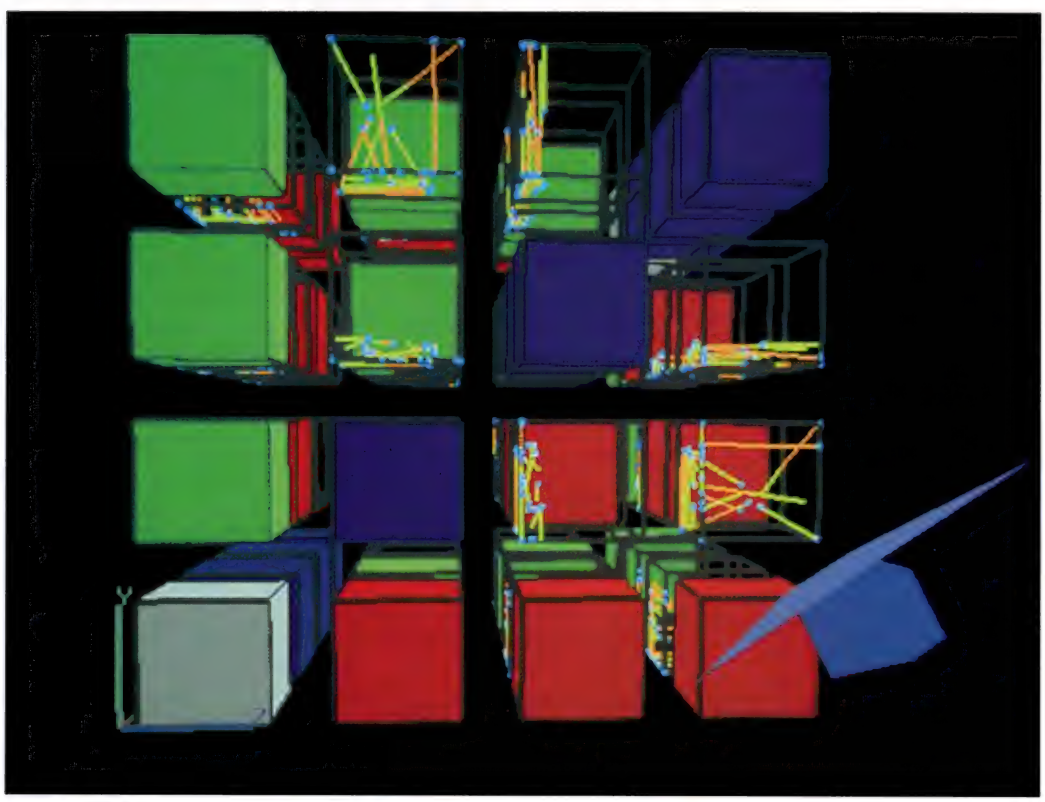

Computational Modeling for Crash-Worthiness of Electric Vehicles Using Nonlinear Finite Element Methods

This project uses transient nonlinear finite element analysis to model the crash-worthiness of a vehicle modified from gasoline to electric power. The modification changes the dynamic structural response of the vehicle during a collision, and designers must ensure occupant safety as the vehicle components undergo plastic deformation. Finite element models allow investigation of the deformed geometry and buckling patterns of the vehicle over a series of time steps. They also permit examination of key response quantities such as effective stress and effective plastic strain.

CATEGORY
Engineering

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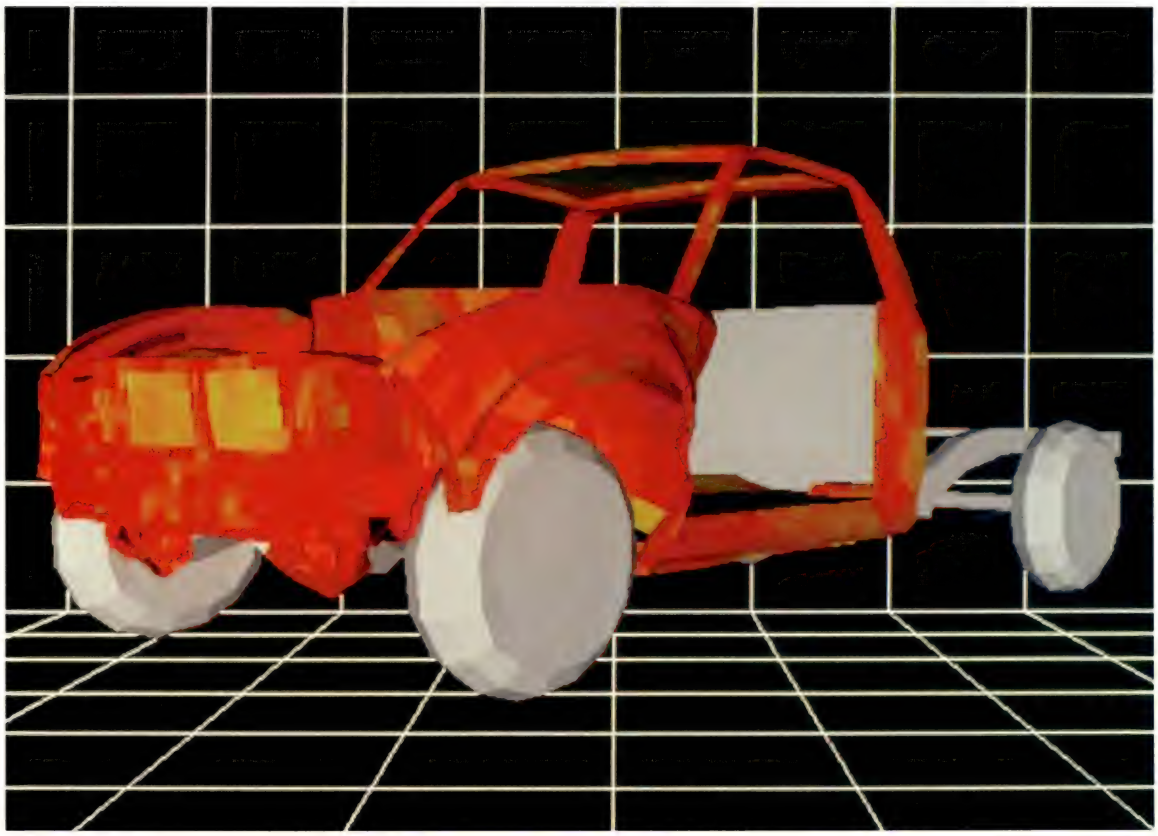
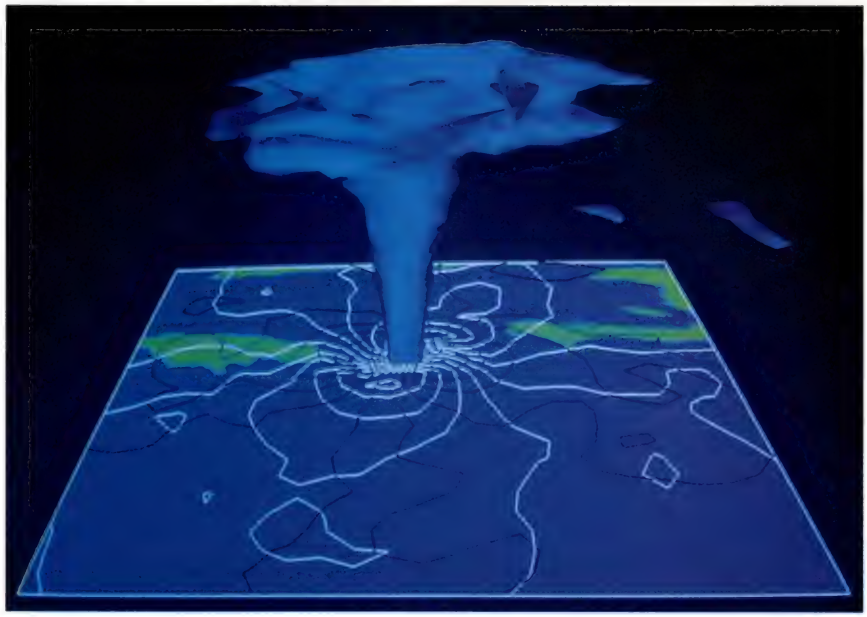


The SIGGRAPH 94 Daily Weather Forecast



Interactive 3D visualization has proved its value for finding and understanding problems with numerical simulations of the atmosphere. Scientists are able to scan through large simulations quickly, looking for problems, and then trace back through simulated time to find the root causes of those problems by comparing different model fields and looking at the geometry of those fields from various angles.

This project demonstrates the current two-day forecast of Florida weather, made with the UW-NMS modeling system and visualized using the VIS-5D software. Virtual reality is used to present the high spatial and temporal resolution of numerical weather forecasts.

CATEGORY
Atmospheric Science

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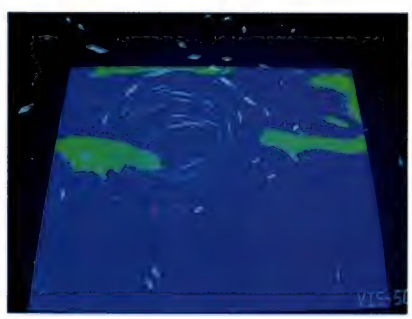

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The SANDBOX: Scientists Accessing Necessary Data Based On eXperimentation

Scientific databases contain enormous amounts of data collected through experimentation. They are accessed by investigators from many disciplines, most of whom are unfamiliar with databases and their associated query languages. Using the SANDBOX, an investigator places virtual instruments into a virtual reenactment of the original experiment and collects data from the scientific database in much the same way that the original data were collected.

This prototype of the SANDBOX allows an investigator to access parts of NASA's FIFE scientific database, which contains data from ground experiments, airborne instruments, and satellite photographs for developing ways to measure surface climatology from satellite information.

CATEGORY
Earth Science

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ACKNOWLEDGEMENTS
We gratefully acknowledge the assistance of Narendra Goel, John Norman, and Don Strebel for their insight into the FIFE database.

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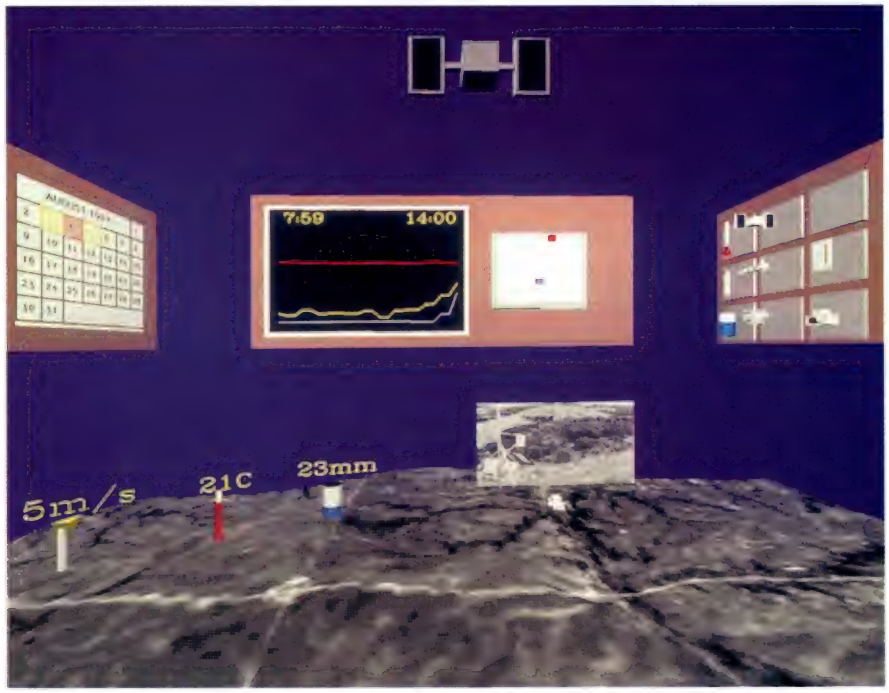

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Wayne State University

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C O L O P H O N

Production of the SIGGRAPH 94 Visual Proceedings combined the most sophisticated image processing technology with the most advanced image reproduction techniques.

All of the images throughout the publication were processed with stochastic technology, a new frequency-modulated screening system that defines tonal gradation with carefully randomized micro dots (20 microns).

Stochastic screening offers several major benefits:

- No moiré patterns, because stochastic halftones have no fixed screen rulings or angles.
- Elimination of screen angles also allows five-, six-, and seven-color process printing.
- Greater ink density for full and vibrant reproduction.
- Press make-ready time is shortened and paper waste is reduced.

Robert Kushner, Printing Broker, who has printed the SIGGRAPH Conference Proceedings for the past 14 years, was eager to use the new technology and worked with Jeff McCord of Free-Lancelot, Quorum Incorporated (SIGGRAPH 94 and 95 designers), and Steve Cunningham (SIGGRAPH Director of Publications) to review production tests and assure printing viability.

Design

The Quorum design and editing team cropped and placed low-resolution placement images and laid out the Visual Proceedings using Macintosh Quadra 840 AVs, Adobe Photoshop 2.5, Adobe Illustrator 5.0, and QuarkXPress 3.3. The type was set with Adobe Gill Sans.

Electronic Color Prepress

Jeff McCord, working with Photoshop production artist Wally Chin and production assistant Caroline Albert then had all of the slides and transparencies scanned onto Kodak Photo-CD and Pro Photo-CD.

Free-Lancelot used a Macintosh Quadra 800 with 56 Mb RAM, a 2 GIG array hard drive, NEC MultiSpin CD-ROM reader, and a second computer (accelerated Mac II), linked via Ethertalk for other production and nightly DAT backups. Daystar Digital provided the use of a Charger board for Adobe Photoshop acceleration.

After exhaustive testing of various Photo-CD **acquire** modules and **open as** settings, Free-Lancelot opened the images into Photoshop using Kodak's KEPS CMS **open as** software and Daystar Digital's newly released ColorMatch software with "Universal Ektachrome" and "AgfaProof" settings.

The images were then sized and cropped to match the layout that Quorum provided. Unsharp masking was used with settings of 125%, [1] pixel radius, and [3] threshold.

The images were adjusted using the **curves** control to boost the highlights, adjust the shadows, and remove any unintended color cast. Lastly, the images were placed into the QuarkXPress layouts and put on disk for output at Fong & Fong Printers and Lithographers.

Fong & Fong's color department is one of a handful of plants that currently specializes in using Agfa's CristalRaster stochastic screening technology for film output. Disks were shipped periodically with the QuarkXPress 3.3 files and all the graphics enclosed. Fong & Fong's David Gerharter double-checked the files and handled the output and proofing on an Agfa SelectSet 7000 image setter.

Finally, the pages were shipped to Robert Kushner and The Press of Ohio for stripping and printing.

Printing

The Visual Proceedings was printed on two separate presses. The cover was printed on a six-unit Heidelberg Speedmaster, Model 102SB (28" x 40" sheet fed). The text was printed on an eight-unit Harris M-300 (35" heatset web).

Printing plates were ANITEC Manuscript 100 with plate burning and development equipment calibrated under Agfa technical supervision. Film was stripped on a Misomex Auto-Stripper.

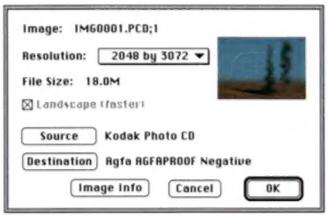
Finishing and binding: The cover is film laminated with 3 mil acetate and adhesive bound (perfect) to text with 1/4" hinges on two sides.

Visual Proceedings Production:

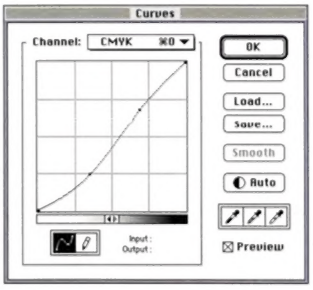
Jim Reitz, Quorum: designer, page layout
Tom Rieke, Quorum: editor
Todd Szymanski, Quorum: design supervision
Robin Myran, Quorum: text coordination, proofing
Robert Kushner, Printing Broker: production coordinator
Jeff McCord, Free-Lancelot: image adjustment, electronic color pre-press
Wally Chin: Photoshop production
Caroline Albert: production assistant
Argentum: Kodak Photo-CD scans
Pacific Color: Pro Photo-CD Scans
Fong & Fong: Agfa CristalRaster film output
The Press of Ohio: printing and binding

Image from **Seasons of Life**, *Midori Kitagawa-DeLeon, shown using stochastic screening.*

Same image using 133 LPI conventional four-color separations.



Open as *settings using Kodak's KEPS and Daystar Digital's ColorMatch in Photoshop.*



Typical Photoshop **curves** *adjustment for Kodak Photo-CD images which didn't require much color correction*

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